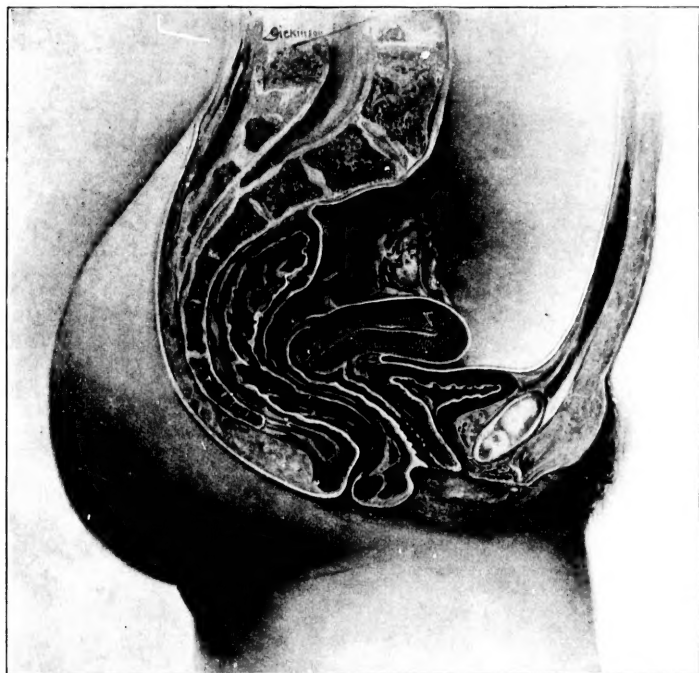


FRONTISPIECE.



Mesial section showing the relation of the viscera in their normal positions (Dickinson).

(For details see Fig. 22, p. 42.)

Fig. 23 (p. 42)
 of brim."
 Fig. 33 (p. 42)
 Fig. 200 (p. 42)
 one-sixth of
 Fig. 211 (p. 42)
 Fig. 205 (p. 42)
 legend.
 Pl. 19 (p. 42)
 and the same
 weeks. 2.

AN AMERICAN TEXT-BOOK OF OBSTETRICS

FOR PRACTITIONERS AND STUDENTS

BY

JAMES C. CAMERON, M.D., EDWARD P. DAVIS, M.D.
ROBERT L. DICKINSON, M.D., CHARLES WARRINGTON
EARLE, M.D., JAMES H. ETHERIDGE, M.D., HENRY J.
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ERRATA.

Fig. 23 (p. 43). The labelling on the cut of "axis of brim" should be "plane of brim."

Fig. 33 (p. 48). In the legend, for "multiparae" read "nulliparae."

Fig. 209 (p. 385). In the legend, the (one-sixth natural size) should be (fetus one-sixth natural size).

Fig. 211 (p. 388). In the legend, for "axis of inlet" read "plane of inlet."

Fig. 205 (p. 456). The figures A and B should be reversed to agree with the legend.

Pl. 19 (p. 166). The legend should read as follows: 1. The non-gravid womb and the same at eight months, with varying heights of the fundus marked in weeks. 2. Position of the child and the uterus in a case of pendulous abdomen.

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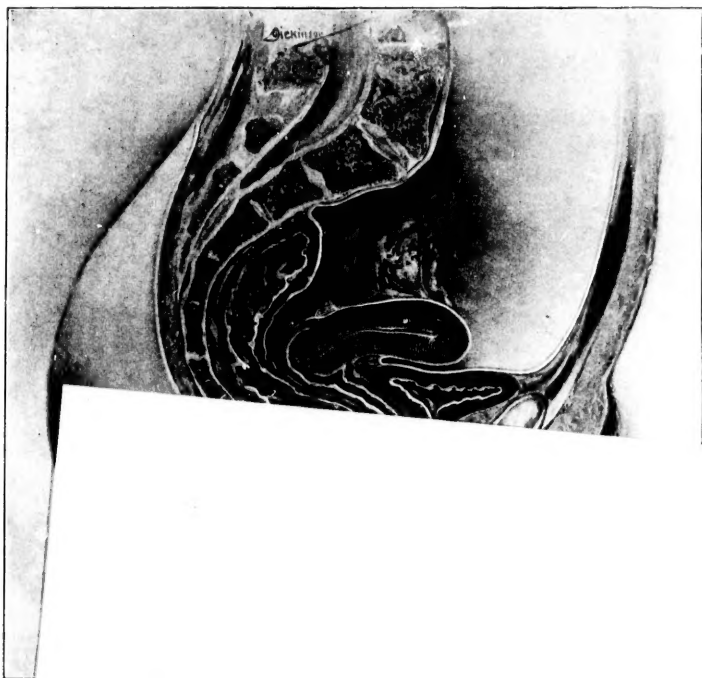
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FRONTISPIECE.



Mesial section showing the relation of the viscera in their normal positions (Dickinson).
(For details see Fig. 22, p. 42.)

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HALF-TONE ILLUSTRATIONS.*



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PREFACE.



ADVANCES in the science and art of obstetrics have kept pace with the advances which have characterized all branches of medicine and surgery. Although our standard text-books of obstetrics have occasionally been *revised*, an entirely new text-book containing the writings of more than one individual has not appeared during the last decade. The AMERICAN TEXT-BOOK OF OBSTETRICS owes its existence to the fact that it seemed practicable to produce a work which should not only embody the teachings of several prominent American obstetricians, thus reflecting all recent progress made in the theory and practice of obstetrics, but should also be a standard teaching-work for students and a guide for practitioners; for this purpose the authors selected are those possessing experience as teachers of obstetrics in several of the leading medical schools and hospitals of America.

The especial design in preparing this volume was to make clear those departments of obstetrics that are at once so important and usually so obscure to the medical student. Therefore the obstetric emergencies, the mechanics of normal and abnormal labor, and the various manipulations required in obstetric surgery are all described in great detail, the text being elucidated with numerous illustrations and diagrams which will materially assist the student to grasp the complex problems of operative obstetrics. The diseases of the fetus and of the new-born infant are given separate sections of the volume, this subject being discussed more fully than is usual in obstetrical works in the English language. An effort has been made to render attractive the sections upon Anatomy and Embryology.

While the various authors were each assigned special themes for discussion, nevertheless an attempt has been made so to correlate the subject-matter as to preserve throughout the text a logical sequence not always found in composite publications. The writing of the subjects assigned to Dr. Charles Warrington Earle was only fairly begun when his untimely and widely-lamented death occurred. The Editors were gratified to secure for the revision and completion of Dr. Earle's manuscript one of his associates, Dr. M. J. Mergler. The table of Contents indicates the authorship of each section—a feature which doubtless will give satisfaction.

One of the just claims of this text-book to originality is that an attempt has been made to carry out systematically the following principles in its illustration: All figures to be drawn to scale; a uniform scale to be adopted, usually one-third or one-sixth life size; in sagittal sections the same half always to be shown for ease of comparison; full labelling to be made directly on the drawing, to which should be given as much artistic treat-

ment as would be compatible with clearness and with teaching quality. The scale of the cuts in most previous text-books, and the choice of the sagittal section—right or left—have varied. In this book the left half of the section has preferably been chosen, because it is the one made familiar to practitioners by the treatment of patients in the latero-prone posture.

Each borrowed engraving has been credited to its source in all cases where it could be traced. When alterations have not been extensive these cuts are designated, respectively, as "redrawn from" or "modified from" the original. When such corrections and additions have been made as to constitute practically a new drawing, the origin of the cut is rarely indicated. Where there may seem to be strong resemblance to older work, without credit, it will be found that new photographs or sketches are the basis of the new illustration. The borrowed cuts have all been redrawn, excepting those reproduced from the old copper-plates of Hunter and Smellie—a standard of artistic excellence set for us by the most famous engravers of England. France, which has furnished our specialty with its stock-cuts for decades, gives the "American Text-Book" many suggestions through the work of Farabeuf and Varnier. To Germany obstetrics owes much gratitude for that accuracy in topographical anatomy which had its rise in the beautifully pictured sections of Braun, Schroeder, Waldeyer, and Zweifel; while we thank Scotland, through the atlases of Hart, Barbour, and Webster, for the knowledge of the structure of the pelvic floor.

Some of the finest pathological specimens illustrated in this text-book were photographed at the Army Medical Museum at Washington, D. C., through the painstaking courtesy of Dr. D. S. Lamb, while Dr. Farquhar Ferguson gave access to the New York Hospital Cabinet, and Professors Piersol and Hirst each brought forward some of their most striking preparations.

We are indebted to the staff of artists, Messrs. Max Colin, W. A. C. Pape, H. C. Lehmann, F. V. Baker, A. B. Doggett, F. Deck, W. H. Richardson, and others, by whose skill and years of patient labor art has been placed at the service of scientific illustration.

Only through an unprecedented liberality on the part of the publisher of a medical text-book has it been possible thus to re-illustrate an entire department of medicine. To Mr. W. B. Saunders, for his unremitting courtesy, patience, and generosity, we tender our thanks. The Editors desire to acknowledge their indebtedness to Mr. John Vansant for valuable assistance in conducting the mechanical details of the work and for the preparation of the Index.

The plan of this text-book, the exposition of only the latest ideas in pathology, the especial care that directions for treatment shall be particular and full, the avoidance of conflicting statements, and the wealth of illustration, are qualities which, it is hoped, will make this work an efficient guide to those who study or who practise Obstetrics.

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* "General Changes" (pp. 153-159) contributed by Dr. Palmer.

† The manuscripts of Dr. Earle were revised and completed by Dr. M. J. Mergler.

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* "Lacerations and Rupture of the Uterus" (pp. 610-616) contributed by Dr. Schwarz.

† "Hematoma" (pp. 680-683) contributed by Dr. Norris.

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* "Symphysiotomy" (pp. 905-917) contributed by Dr. Jewett.

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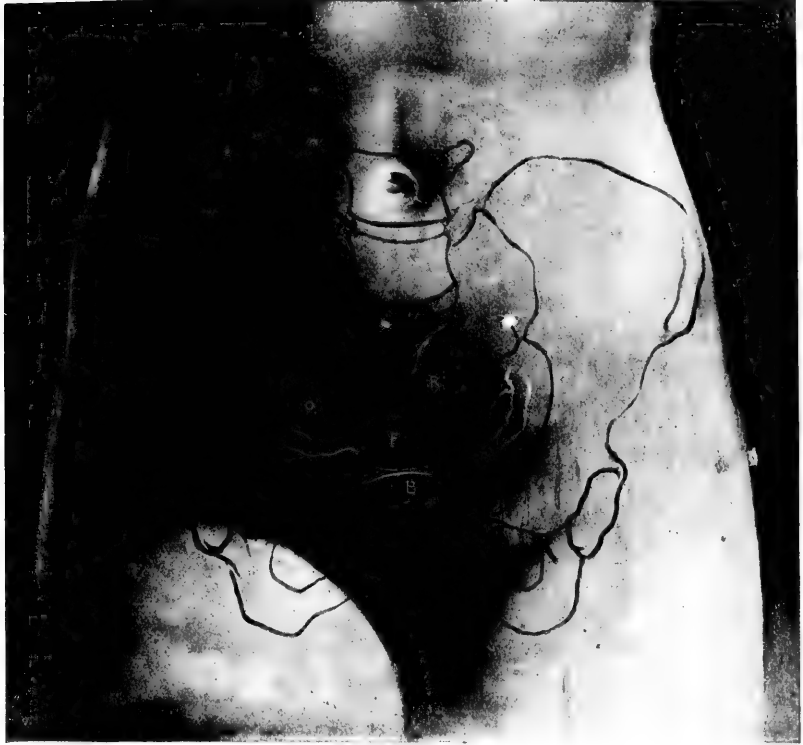
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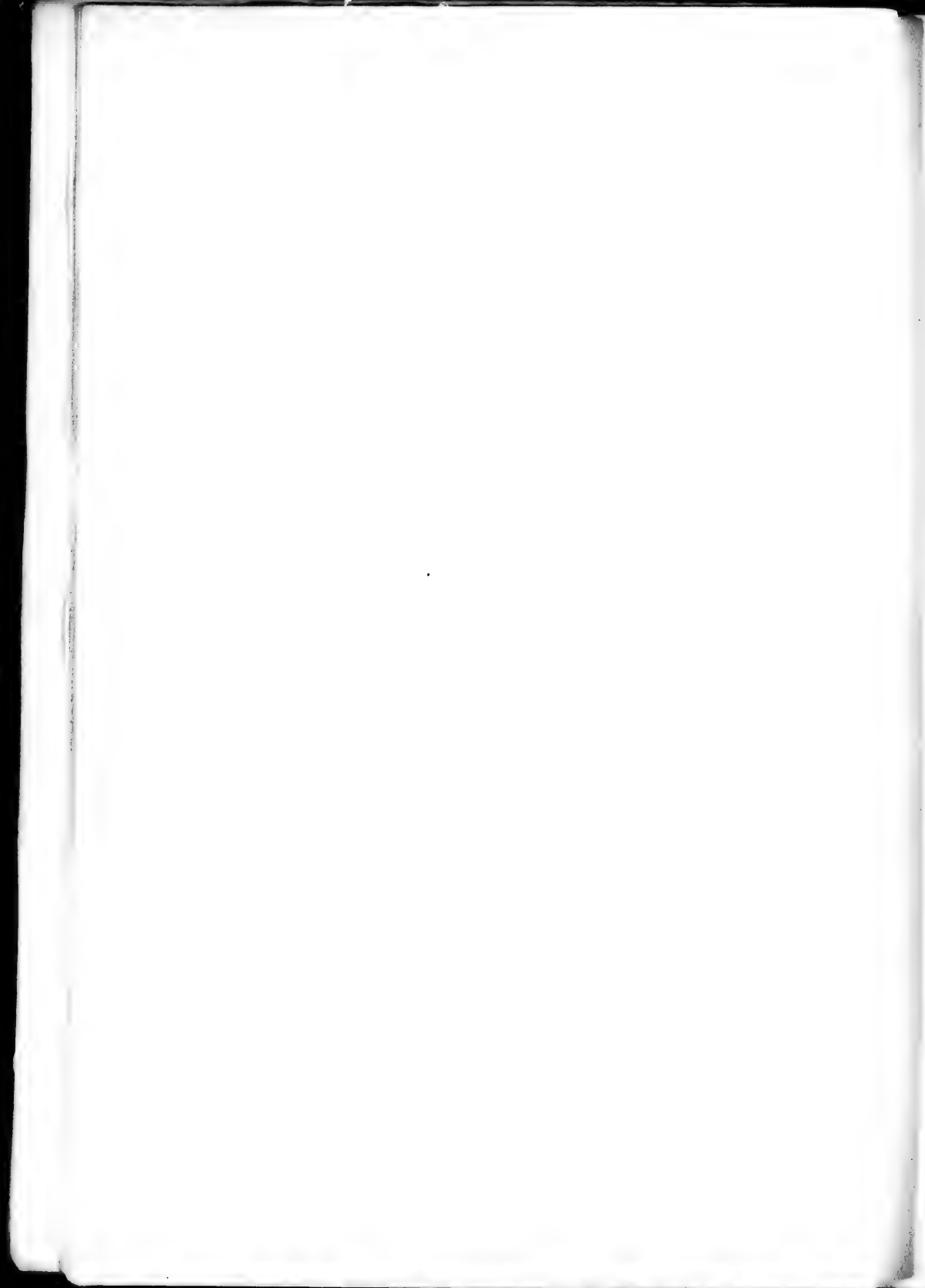
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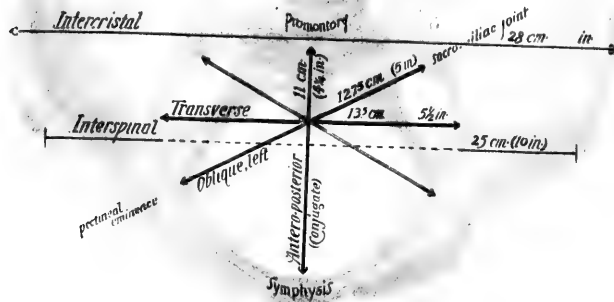
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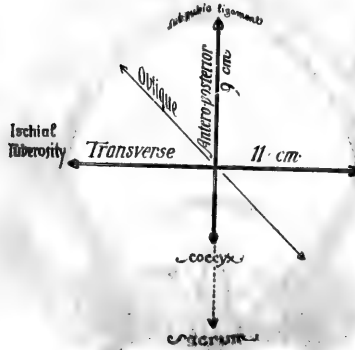


The relation between the pelvis and the pelvic organs and the surface of the body: v, promontory of the sacrum; s, symphysis pubis; f, fundus of the uterus; o, the ovary embraced by the Fallopian tube; the line of the psoas muscle indicated; n, the rectum.





1



2

1. Diameters of pelvis at brim, with transverse iliac diameters. 2. Diameters of pelvic outlet.

AN AMERICAN TEXT-BOOK OF OBSTETRICS.

I. THE GENERATIVE ORGANS.

I. ANATOMY OF THE PELVIS.

FOUR bones—the two *ossa innominata*, the *sacrum*, and the *coccyx*—take part in the formation of the pelvis; each of these, in turn, is composed of a number of segments which in early life are distinct and united by intervening cartilage. The pieces comprising the innominate bone—the *ilium*, the *pubis*, and the *ischium*—earliest unite, although the union of the several portions of the acetabulum is not complete until from the eighteenth to the twentieth year. The sacral and the coccygeal segments fuse still later, those of the coccyx re-



FIG. 1.—Female pelvis (one-third natural size).

maining movable until middle life, while the attachment of this bone with the sacrum occurs late in life. During the usual period of childbearing, therefore, the segments composing the posterior boundary of the pelvis are ununited, and, in the lower or coccygeal part of the wall, are capable of yielding to the demands of parturition for increased antero-posterior or conjugate pelvic diameters.

The pelvis viewed in its entirety presents an inverted truncated cone (Fig. 1),

slightly compressed from before backward, whose base is directed upward and forward, and whose smaller end looks downward and backward. The sacrum and the coccyx occupy a median position behind, and contribute the posterior wall, the innominate bones expanding laterally and meeting in front to form the pubic arch and symphysis.

The space included within these bony walls is divided into two parts by a plane passing through the middle of the sacral promontory behind and the upper border of the symphysis pubis in front. The portion of the body-cavity lying below this plane constitutes the *true pelvis*; the portion lying above this plane, included within the widely expanded iliac bones, the vertebral column, and the abdominal parietes, constitutes the *false pelvis* and belongs to the abdominal cavity, to the contents of which it affords support and protection.

The *true or lesser pelvis* is a short curved canal whose *superior strait*, or *inlet*, is marked by the *brim*, a bony ring defined by the anterior border of the promontory of the sacrum behind, the ilio-pectineal lines laterally, and the posterior margin of the pubis in front. The plane of the *inferior strait*, or *outlet*, passes through the tip of the coccyx, the tubera ischii, and the lower border of the symphysis pubis. In addition to the foregoing planes marking the upper and lower boundaries of the true pelvis, two others, corresponding with its widest and most contracted parts, are recognized with advantage.

The plane of *greatest pelvic expansion* extends from the union between the second and third sacral vertebrae behind to the middle of the symphysis pubis in front, its lateral boundaries corresponding on either side with the mid-point of the inner surface of the acetabulum.

The plane of *least pelvic diameter* lies somewhat lower, being defined by lines passing through the sacro-coccygeal articulation, the ischial spines, and the lower third of the symphysis pubis: this plane, marking as it does the point of greatest permanent constriction, really constitutes the pelvic outlet in an obstetrical sense more than do the lower and more yielding confines to which the term is usually applied.

The *superior strait*, or *inlet*, of the true pelvis is slightly cordiform in outline, since the low-arched posterior border of its generally oval figure is encroached upon by the sacral promontory, the indentation, however, being much less in the female than in the male pelvis.

The *dimensions of the inlet* (Pl. 2, Fig. 1) are represented by the antero-posterior or conjugate diameter of 11.5 centimeters ($4\frac{1}{2}$ inches), measured from the middle of the promontory of the sacrum to the middle of the upper border of the symphysis pubis, and the transverse diameter of 13.5 centimeters ($5\frac{3}{4}$ inches), determined by the greatest distance between the ilio-pectineal lines; since, however, the pubic portion of the pelvic brim lies slightly in advance of the posterior surface of the pubis, the available antero-posterior diameter, or *obstetric conjugate*, is somewhat less than the anatomical dimension, measuring 11 centimeters (Pl. 2, Fig. 2). Supplementary to these measurements, the oblique diameters of 12.75 centimeters ($5\frac{1}{4}$ inches), measured from the intersection of

the sacro-iliac articulation with the ilio-pectineal line to the pubic spine of the opposite side, are usually noted. The measurements of the *plane of greatest expansion* include an antero-posterior diameter of 12.75 centimeters ($5\frac{1}{4}$ inches) and a transverse diameter of 12.5 centimeters (5 inches). The *plane of least dimensions* possesses an antero-posterior diameter of 11 centimeters ($4\frac{3}{8}$ inches), as measured between the end of the sacrum and the summit of the pubic arch, and a transverse diameter of 11 centimeters ($4\frac{3}{8}$ inches), taken between the inner surface of the ischial bones near their posterior border; the distance separating the spinæ ischii is about 10.5 centimeters ($4\frac{1}{4}$ inches).

The *inferior strait*, or anatomical outlet, of the pelvis, although less regular in outline than the inlet, possesses a general ovate form, the smaller end of the figure being directed anteriorly, while its larger end is impressed by the prominence of the coccyx; in addition to the latter point, two other osseous projections, the tubera ischii, aid in defining the boundaries of the outlet. Between



FIG. 2.—Female pelvis, viewed from below, with ligaments (one-third natural size).

these tuberosities in front is included the subpubic arch, bounded by the pubic and ischial rami, while behind, between them and the sacrum, lie the deep sacro-sciatic notches, which are bridged over and converted into foramina by the greater and lesser sacro-sciatic ligaments (Fig. 2).

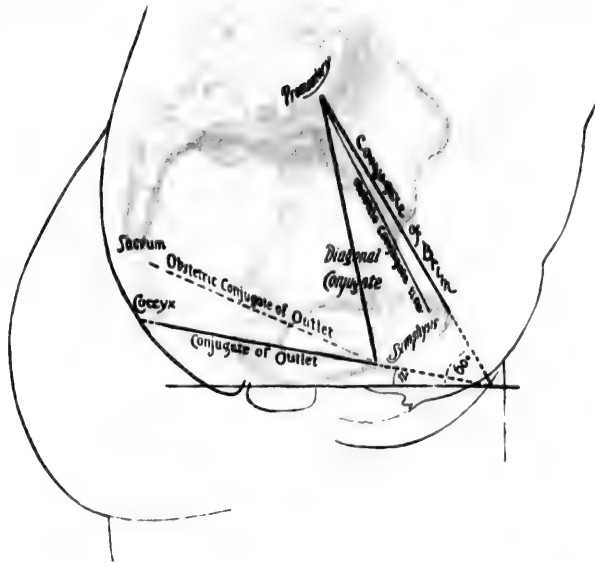
The *dimensions of the plane of the pelvic outlet* (Pl. 2, Fig. 2) include the antero-posterior diameter of 9 centimeters ($3\frac{1}{2}$ inches), measured from the tip of the coccyx to the summit of the pubic arch, and the transverse diameter of 11 centimeters ($4\frac{3}{8}$ inches), measured between the middle of the ischial tuberosities. It must be remembered, however, that while the antero-posterior diameter under ordinary conditions is only 9 centimeters ($3\frac{1}{2}$ inches), the mobility of the coccyx is usually such that this diameter, or obstetric conjugate, is increased to 11 centimeters during parturition (Pl. 2, Fig. 2).

The *cavity* of the true pelvis, as appears from the foregoing, is an irregular cylinder of somewhat varying diameter; the imaginary *pelvic axis* is produced

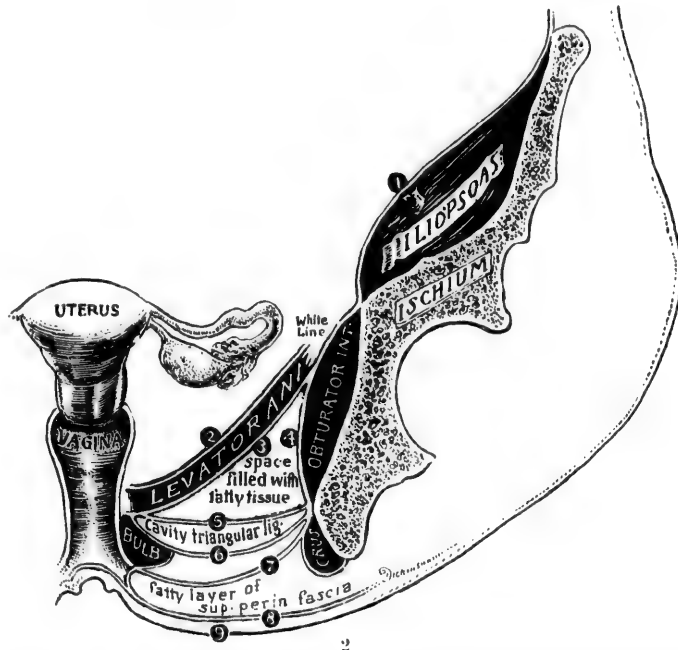
by uniting the central points of the antero-posterior diameters of the superior, the inferior, and the intermediate planes above described. The pelvic cavity is enclosed by the smooth surfaces presented by the surrounding bony parts; its anterior wall, formed by the symphysis and the bodies of the pubic bones, is convex and shorter than the posterior, measuring but little more than 4 centimeters (about $1\frac{1}{2}$ inches) in depth; its posterior wall, including the concave anterior surfaces of the sacrum and the coccyx, is much longer, extending 11.5 centimeters (about $4\frac{1}{2}$ inches) from the sacral promontory to the end of the coccyx. The lateral walls correspond with the broad quadrilateral surfaces of the ischial bodies, and present an intermediate depth of 9 centimeters ($3\frac{1}{2}$ inches).

The *position* of the pelvis, evidently, must vary with the changes in the posture of the body. In the erect attitude the plane of the inlet of the true pelvis is well elevated, forming with the horizontal an angle of about 55° (50° to 60°), the inclination being generally somewhat greater in the female; the plane of the outlet coincides more closely with the horizontal, subtending with the latter an angle of about 11° (Pl. 3, Fig. 1). In the erect position the planes of the perpendiculars let fall from the anterior superior iliac spines and from the symphysis pubis coincide; the base of the sacrum lies about 9 centimeters ($3\frac{1}{2}$ inches) above the upper border of the symphysis, the tip of the coccyx at the same time being about 2 centimeters ($\frac{3}{4}$ inch) above the summit of the subpubic arch. The *axis* of the *pelvic inlet* is directed forward and upward, toward the umbilicus; if prolonged downward, it strikes the tip of the coccyx. The axis of the *outlet*, naturally downward and a little backward, will meet the promontory if extended upward. The plane of the symphysis forms an angle of from 90° to 100° with that of the pelvic brim.

The importance of obtaining definite information concerning the dimensions of the pelvis, but, at the same time, the impossibility of determining many of the foregoing measurements on the living subject, has led to the substitution of external, readily accessible measurements which bear a direct and constant relation to the internal diameters. The most useful of these external measurements include—the distance between the anterior superior iliac spines, 26 centimeters; the distance between the iliac crests, 29 centimeters; the distance between the greater trochanters, 31 centimeters; the distance between the spinous process of the last lumbar vertebra and the upper margin of the pubic symphysis, or *external conjugate*, $20\frac{1}{4}$ centimeters; the distance between the posterior superior spinous process and the anterior superior spinous process of the opposite iliac bone, or the *oblique diameter*, 22 centimeters; the distance between the ischial tuberosities, 11 centimeters. These external diameters, which are readily obtained by means of direct measurements by the pelvimeter, bear sufficiently constant relation to the internal diameters to make them of much practical importance. As pointed out by Klein, however, the antero-posterior diameter is subject to considerable normal variation. The average thickness of the bony walls at the points of measurement being known, the subtraction of this amount from the ascertained external diameter evidently



1



2

1. Sagittal section of female pelvis, showing anatomical and obstetrical diameters. 2. Diagram of the structures composing the pelvic floor: 1, pelvic fascia, which at white line splits into recto-vesical fascia (2) and obturator fascia (4), a thin additional sheet, the anal fascia (3), covering the inferior surface of the levator ani muscle; 5, 6, the superior and inferior layers of the triangular ligament; 7, 8, deep and superficial layers of the perineal fascia; 9, skin.



supplies data comparable with the recognized average of the internal dimensions. Thus, the distance between the lower edge of the spinous process of the last lumbar vertebra and the middle of the upper margin of the symphysis, measured by the pelvimeter, is 20 centimeters; from this are deducted the 9 centimeters which represent the combined average thickness of the vertebral body and the pubic symphysis, the remaining 11 centimeters corresponding closely with the conjugate of the superior strait as determined by direct measurement.

The size of the female pelvis, although presenting many individual variations, is not unfavorably influenced by stature, since short women often possess pelves of more than average breadth. The distinctive characteristics of sex are acquired after puberty, although, according to Fehling, indications of these peculiarities are present even at birth. Some asymmetry of the pelvis, as of other parts of the body, is usually to be detected.



FIG. 3.—Male pelvis (slightly less than one-third natural size).

The following table exhibits the average dimensions of the fully developed female pelvis, the measurements being taken from the dried pelvis:

	Centimeters.
Greatest distance between crests of ilia	28
Distance between anterior superior iliac spines	25
Distance between last lumbar spine and front of symphysis pubis	20

TRUE PELVIS.

	Antero-posterior Diameter (Centimeters).	Transverse Diameter (Centimeters).	Oblique Diameter (Centimeters).
Plane of pelvic inlet	11.	13.5	12.5
Plane of greatest expansion	12.75	12.50	
Plane of greatest contraction	11.	11.	
Plane of pelvic outlet	9.5 (increased to 11.5 cm. by displacement of coccyx).	11.	11.5

The *distinguishing characteristics* of the female pelvis (Fig. 1) as contrasted with the corresponding portion of the male skeleton (Fig. 3) include slighter

bones with less marked muscular impressions ; less height of the entire pelvis ; greater breadth and capacity of the true pelvis, but, owing to the more vertically placed iliac bones, relatively and absolutely less expansion of the false pelvis than in the male (Thane). Both the inlet and the outlet are larger in the female, the outline of the pelvic brim approaching more nearly the circular form, owing to the slighter projection of the sacral promontory. In the female pelvis the sacrum is broader and less concave, the depth of the symphysis is less, and the subpubic arch is wider, embracing from 90° to 100° as against 70° in the male.

In addition to individual peculiarities, the influences of race markedly impress the general form of the pelvis, particularly the relation of the antero-posterior to the transverse diameter: the broad, cordiform outline of the Caucasian female pelvis is replaced by one nearly circular among the native Australians ; among the Bushman and Malay women the usual ratio between the conjugate and transverse diameters becomes so altered that the outline of the pelvis is an upright oval, the antero-posterior dimension surpassing the transverse.

Articulations of the Pelvis.—The component bones of the pelvis are united with one another by four articulations (Fig. 4): one in front, between

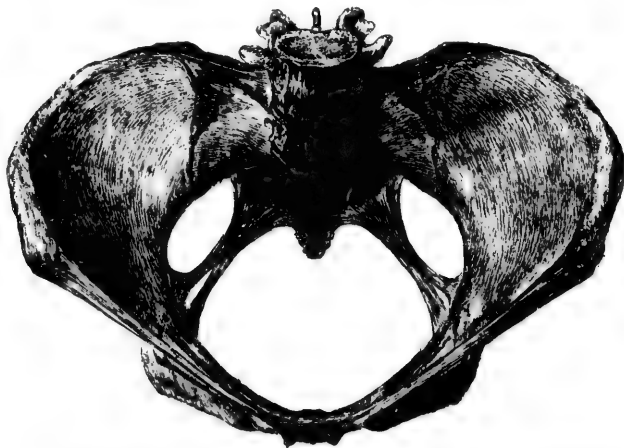


FIG. 4.—Female pelvis (viewed from above) with ligaments (one-third natural size).

the two pubic bones ; two behind, between the iliac bones and the sacrum ; and one between the sacrum and the coccyx. The opposed bony surfaces are closely united by fibro-cartilaginous plates and external ligamentous bands, and admit of very limited motion ; these articulations, therefore, are usually classed as amphiarthroses or symphyses.

The pubic articulation, or *symphysis pubis* (Figs. 5, 6), is formed by the approximation of the two oval articular facets occupying the mesial borders of the pubic bones, which are connected by the interposed fibrous disk and the sur-

rounding external ligaments. The slightly convex surfaces are covered with plates of cartilage which fill up the inequalities of the bones, the opposed surfaces being held together by the intervening mass of fibrous tissue and fibro-car-



FIG. 5.—Section across symphysis pubis, showing interpubic disk.

tilage constituting the *interpubic disk* (Fig. 5). This layer, which projects anteriorly and posteriorly beyond the adjacent bony margins, is thickest in front; the deficiency of the intermediate tissue above and behind sometimes results in the formation of an interspace or fissure. The fissure within the interpubic disk extends usually about half the length of the cartilage, and is produced during life by the absorption of the fibro-cartilage: it appears after the seventh year, and is of larger size and more constant in the female. While undue tension exerted upon the joint during labor may predispose to the production of this fissure, the latter is not a sequence necessarily of pregnancy, as is shown by its existence in pelvises of males and of virgins. A slight separation of the pubic symphysis during pregnancy is regarded by many as probable; this tendency, however, is reduced to a minimum through the bracing effected by the decussating fibres of the oblique muscles. The external ligaments which additionally strengthen this articulation are the anterior, the posterior, the superior, and the inferior.

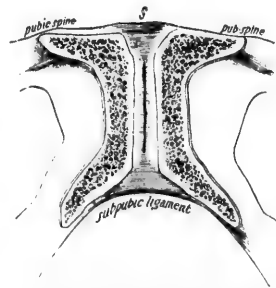


FIG. 6.—Frontal section through symphysis pubis, exposing interpubic cleft (Farabeuf).

The *anterior pubic ligament*, of considerable thickness, consists of several strata of interlacing fibres, the deepest of which passes directly across between the bones in front of the interpubic disk, with which they are blended; the superficial layers include oblique interlacing fibres continued from the tendons of the external oblique and the recti muscles, and of the more superficial adductors of the thigh.

The *posterior pubic ligament* consists of a few sparingly distributed fibres which unite the bones behind, and it is little more than the somewhat thickened periosteum.

The *superior pubic ligament* is represented by a meagre bundle of fibres occupying the upper surface of the articulation.

The *inferior* or *subpubic ligament*, on the contrary, is thick and triangular in form, and it contributes the smooth boundary to the summit of the subpubic arch. Throughout the middle of its span the ligament is closely united

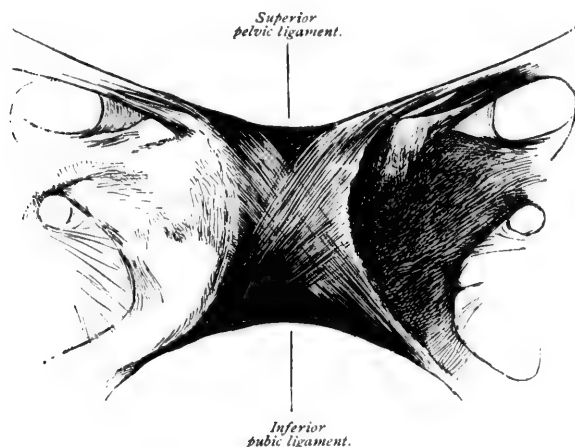


FIG. 7.—Anterior view of symphysis pubis.

with the interpubic disk, being attached at the sides and below to the descending pubic rami (Fig. 7).

The *sacro-iliac articulation* (Fig. 8) lies between the lateral surfaces of the sacrum and the ilium; the rough articular surfaces of both bones are covered by thin plates of cartilage, that on the sacrum being thickest. With the advance of age these cartilages often become roughened and partially separated by spaces containing a glairy fluid. Not infrequently the apposed bones are united by intervening bundles of fibrous tissue, these bands constituting the interosseous ligament. The principal bonds of union are the anterior and posterior ligaments.

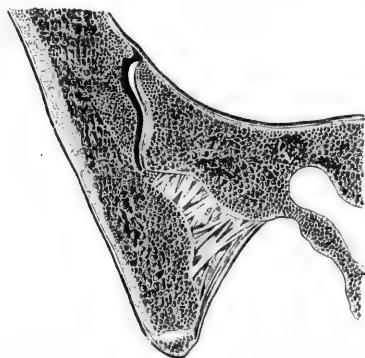


FIG. 8.—Section through the left sacro-iliac articulation (Luschka).

The *anterior sacro-iliac ligament* comprises a number of thin irregular fibrous bundles stretching between the front of the sacrum and the adjacent border of the iliac bone. Associated with the upper and lower margins of this ligament are thickened bundles of fibrous tissue that spread over the ilium respectively as far as the ilio-pectineal line and the posterior iliac spine;

these bands constitute the *superior* and the *inferior sacro-iliac ligaments* sometimes described.

The *posterior sacro-iliac ligament*, which is of great strength, extends between the back of the sacrum and the posterior border of the iliac crest. The general direction of the fibres is downward and inward from the ilium; some of the fasciculi, however, pass almost horizontally, while a special bundle extends nearly vertically from the posterior superior iliac spine to the third and fourth sacral segments, and forms the *oblique sacro-iliac ligament*.

The *sacro-coccygeal articulation* includes the oval facet at the end of the sacrum and the base of the coccyx, and it corresponds in its ligamentous structures with the intervertebral joints, to which series it belongs. The bones are united by the anterior, the posterior, and the lateral bands as well as by the interposed intervertebral disk.

The *anterior sacro-coccygeal ligament* is the continuation of the anterior common ligament of the vertebræ, and it consists of a few irregular bands of fibrous tissue that pass from the anterior surface of the sacrum to that of the coccyx to blend with the periosteum.

The *posterior sacro-coccygeal ligament*, stronger than the preceding, is the prolongation of the posterior common ligament, and it descends from its attachment around the lower orifice of the sacral canal, the lower hind wall of which it largely forms, to the posterior surface of the coccyx.

Additional posterior bands descend from the sacrum to the coccyx as continuations of the interspinous ligaments intimately blended with the aponeurosis of the erector spinæ; the lateral expansions which connect the cornua of

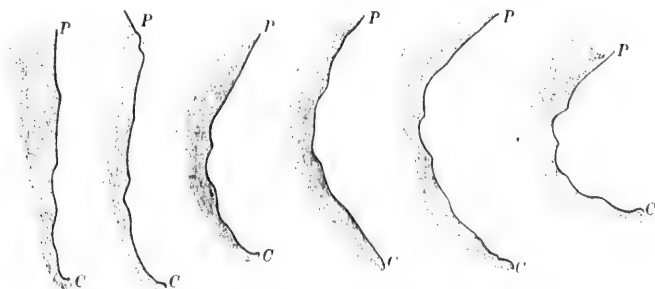


FIG. 9.—Variation in sacral curves (Hirst): P, promontory of sacrum; C, coccyx.

the last sacral segment to the coccygeal cornua constitute the *supracornual* or *lateral ligaments*. The intertransverse ligament is represented by fibrous bands which pass from the lower lateral angle of the sacrum to the transverse process of the first piece of the coccyx.

The *intervertebral disk* is a rudimentary member of the series of fibro-cartilaginous plates interposed between the vertebræ; a distinct cavity sometimes exists within this disk (Cruveilhier), especially when the coccyx is freely movable; this mobility seems increased during pregnancy.

The coccygeal segments are held together by the extensions of the anterior and posterior ligaments and by the rudimentary intervertebral disks which lie between. The individual pieces remain distinct in the female during early adolescence, but become united by the close of the childbearing period; in later life ossification between the sacrum and the coccyx sometimes takes place.

Closely associated with the boundary of the true pelvis are the important sacro-sciatic ligaments.

The *great* or *posterior sacro-sciatic ligament* extends from the posterior inferior spine of the ilium, the lower tubercles of the sacrum, and the inferior portion of the lateral border of the sacrum and the coccyx to the inner margin of the ischial tuberosity, whence the fibres are continued along the inner edge of the adjoining ramus as the falciform process, the concave border of which affords attachment for the obturator fascia.

The *lesser* or *anterior sacro-sciatic ligament*, triangular in form, passes from its wide attachment on the lateral margin of the sacrum and the coccyx to the spine of the ischium, thus dividing the large space enclosed by the great sacro-sciatic ligament into an upper larger opening, the great sacro-sciatic foramen, and a lower smaller aperture, the lesser sacro-sciatic foramen. The anterior boundaries of these foramina are respectively the greater and lesser sacro-sciatic notches of the innominate bone.

Muscles of the True Pelvis.—The osseous and ligamentous framework of the true pelvis is supplemented by muscles and fascia which complete its boundaries as well as somewhat lessen its capacity, these structures, however, being so located that they but slightly diminish the size of the parturient canal. In order to facilitate a study of the fasciæ, a consideration of the muscles related to the cavity and floor of the true pelvis first claims attention. These muscles, on each side, are four in number—the obturator internus, the pyriformis, the levator ani, and the coccygeus.

The *obturator internus* muscle (Pl. 3, Fig. 2) comes in close relation with the pelvic cavity throughout a considerable part of its extended origin, which includes almost the entire part of the pelvis contributed by the innominate bone. The muscle arises from the inner surface of the obturator membrane, except at its lower part, the fibrous arch completing the canal for the obturator vessels and nerve, and the inner surface of the innominate bone anteriorly and internally between the obturator foramen and the margin of the pubic arch, and posteriorly and externally from the foramen as far as the ilio-pectineal line above and the sacro-sciatic notch behind. The external surface of the muscle rests upon the hip-bone and the obturator membrane; its inner or pelvic aspect is covered by the obturator fascia, the continuation of the pelvie, and comes in relation with the internal pudic vessels and accompanying nerve.

The *pyriformis* muscle arises by digitations from the second, third, and fourth sacral segments between and external to the anterior sacral foramina, from the ilium below the inferior posterior spine, and from the great sacro-sciatic ligament. In its course to the great sacro-sciatic foramen, through

which the muscle escapes to seek insertion into the femur, its fan-shaped mass aids in forming the posterior and outer wall of the pelvic cavity.

The remaining two muscles, the levator ani and the coccygeus, are of especial interest, since they largely supplement the fasciæ in the formation of the septum, or *pelvic diaphragm*, which stretches across the bony canal and materially aids in supporting the vagina and the rectum and in the constitution of the floor of the pelvis.

The *levator ani* (Figs. 10, 11), the most important muscle of the pelvic diaphragm, in general, with its fellow of the opposite side, presents the form of a horseshoe, open in front, rather than that of a funnel, as very commonly stated. The true relations of this muscle have especially been emphasized by Luschka

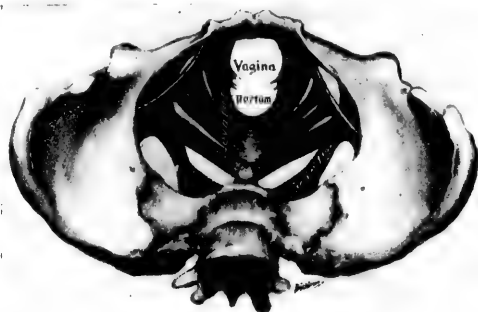


FIG. 10.—Female pelvis, showing the form and attachments of the levatores ani muscles (Dickinson).

and by Dickinson, whose descriptions are here utilized. These two muscles constitute a sling attached to the pubis in front, and, sweeping almost horizontally backward, embrace the vagina and the rectum and become attached posteriorly to the coccyx. While fulfilling the function indicated by its name, the action of

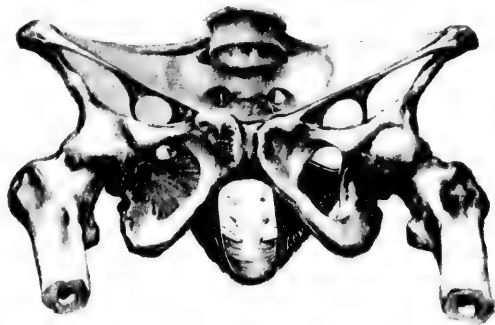


FIG. 11.—Female pelvis, showing the levatores ani muscles from before and below (Dickinson).

the levator ani is especially to drag the lower ends of the vagina and rectum forward to the level of the symphysis. The muscle consists of numerous thin flat bundles often separated from one another by intervals filled by connective

tissue, by means of which all are united into a membranous sheet. The origin of the levator ani is partly bony and partly fascial. The bony origin provides for the anterior and posterior portions of the muscle, the intervening and most extended part arising from the tendinous arch which bridges over the obturator internus.

The *anterior portion* takes origin principally from the horizontal ramus of the pubis, about 1.25 centimeters ($\frac{1}{2}$ inch) from the middle of the symphysis, and 3.5 centimeters ($1\frac{3}{8}$ inches) below the upper border of the ramus.

The *posterior portion* is narrow, being little over .5 centimeter (about $\frac{1}{4}$ inch), and arises from the inner side of the ischial spine in front of the origin of the coccygeus.

The broad *intervening portion* of the muscle springs from fascia along a curved line extending from the back of the pubis to the ischial spine, the lowest point of its sweep lying 5.5 centimeters ($2\frac{1}{8}$ inches) below the ilio-pectineal line. This curved line of tendinous origin closely corresponds with the position along which the division of the pelvic fascia divides into the inner rectovesical lamella and the obturator, the line of separation being marked by thickening of the fascia which produces the tendinous marking or the "white line." The origin of the muscular fibres is by tendinous bands, which may not, however, although closely associated, be directly connected with the line.

The course of the fibres of the various parts of the muscle varies: stretching down and back, the fibres divide into unequal portions, of which one passes to the anterior aspect of the rectum, another to its posterior and lateral surfaces, while the fibres attached to the pubic bone extend along the vagina, with which they are united by strong connective tissue, but do not terminate within its walls. The belly of the muscle sweeps backward, almost horizontally, surrounding the rectum, the margins or edges of the muscular band being often especially thickened; when hypertrophied, as this portion of the muscle sometimes is, severe vaginismus, dyspareunia, and dystocia may result. According to the observations of Dickinson, the inner edge of the levator ani lies about 1.5 centimeters from the vaginal orifice, the position of the muscle being indicated by a sharply defined double band. Contraction of the muscle causes the upper end of the vaginal canal to rise from 15° to 20° toward the pelvic brim. The average muscle exerts a power of ten pounds.

The insertion of the post-rectal part of the levator ani varies with its position: the posterior and smallest part is attached by tendon to the front of the fourth coccygeal vertebra; the middle part becomes aponeurotic and joins its fellow at the tip of the coccyx; and the anterior and largest part unites directly, without tendinous structure, with the muscular bundles of the opposite side.

The *coccygeus* muscle supplements the levator ani behind, presenting a triangular sheet which passes from the ischial spine to the adjacent surfaces of the coccyx and the sacrum. The muscle arises by its apex from the spine of the ischium and from the inner surface of the pelvic fascia, and expands to be inserted by its base into the lateral margin of the coccyx and the lower part

of the sacrum. The pelvic surface of this muscle aids in supporting the rectum, and its external surface is closely related with the lesser sacro-sciatic ligament.

Fasciæ of the Pelvis.—The *pelvic fascia* is the direct continuation of the iliac and transversalis fascial sheets. It is attached laterally along the pelvic brim and around the origin of the obturator internus, and behind it extends over the pyriformis and the adjacent nervous trunks as far as the sacrum; anteriorly it closely follows the outline of the obturator internus, aids in bounding the inner opening of the obturator canal, and at the lower part of the pubic symphysis becomes attached to the anterior pelvic wall.

A thickened band of light colored fascia, the so-called "white line" (see p. 28), which extends from the lower part of the posterior surface of the symphysis to the ischial spine, indicates the position along which an inner or visceral

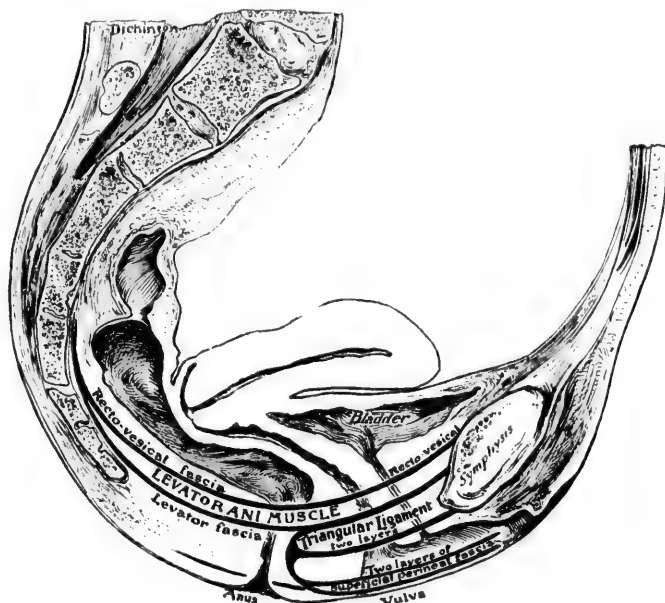


FIG. 12.—Sagittal section showing relations of the several layers of fascia within the pelvic floor (Dickinson).

lamella, the *recto-vesical fascia*, diverges from the parietal or main pelvic sheet; the latter, which adheres to the pelvic wall and covers the obturator internus muscle, is now known as the *obturator fascia*; the latter, therefore, is that part of the parietal lamella of the pelvic fascia that lies below the "white line" and forms the external fascial investment of the ischio-rectal fossa, the deep triangular recess included between the ischial tuberosity and the contiguous parts of the innominate bone and the external and inferior surface of the muscles of the pelvic diaphragm. A thin sheet given off from the parietal layer or obturator fascia below the "white line" covers the under

surface of the levator ani muscle and constitutes the *anal* or *ischio-rectal fascia*. The internal pudic blood-vessels and the accompanying nerve in their course across the outer wall of the ischio-rectal fossa are invested by an additional special layer of the obturator fascia, which thus separates the vessels from the fossa and encloses them within Alcock's canal.

The *visceral lamella*, or the *recto-vesical fascia*, is, as pointed out by Webster, a structure of great importance in enabling the pelvic floor to resist inter-abdominal pressure at the pelvic outlet. Springing from the parietal layer along the "white line," the recto-vesical fascia covers the inner and upper surface of the levator ani and continues over the muscle to the bladder, the vagina, and the rectum, where it divides into four layers—the vesical, the vesico-vaginal, the recto-vaginal, and the rectal.

The *vesical layer* expands over the lower lateral aspect of the bladder, forming of that organ the lateral true ligaments, which become greatly thinned out as they pass over its walls. The anterior part of the visceral lamella on each side is attached to the back of the lower part of the pubis in front, laterally to the symphysis, and behind passes to the anterior surface of the bladder to become the anterior true ligament of this organ: the space between these bands, the pubis, and the bladder, sometimes called the "space of Retzius," is occupied by the *retropubic tissue*, consisting principally of adipose and areolar tissue.

The *vesico-vaginal layer* extends between the bladder and the anterior vaginal wall, and aids in connecting these parts by its firm union with both, blending with the attachment of the posterior part of the bladder to the uterine cervix.

The *recto-vaginal layer* passes between the vagina and the adjacent wall of the lower part of the rectum; the union, except behind the upper part of the vagina, is very intimate, while below, this layer is continuous with the fibrous tissue of the perineal body.

The *rectal layer* extends behind the rectum and is attached to its walls, becoming continuous with the corresponding layer of the opposite side.

The Pelvic Floor.—The exact structures which should be regarded as taking part in the constitution of the pelvic floor has occasioned much discussion, since by some authors its constituents are limited to those structures which directly contribute to the continuity of the septum closing in the pelvic outlet, while by others all parts directly or indirectly contributing to the support of this septum, as the bladder, the upper part of the vaginal canal, the uterus, and the rectum, are included within the category of the floor.

In the present consideration of the pelvic floor only those structures will be included that directly contribute to its formation, thus excluding, with Symington, the bladder and the uterus, and reckoning as belonging to the floor only those portions of the walls of the vagina and of the rectum that lie intimately united with the septum. The close relation which these excluded organs bear to the pelvic floor, however, must not be overlooked, since by their intimate connection with the tissues of the floor, on the one hand, and by

their suspensory apparatus, on the other hand, they exert an important influence, as emphasized by Webster, in supporting the tissues closing the outlet of the pelvis.

The *pelvic floor*, in the sense here accepted, is bounded externally by the skin and internally by the peritoneum, and includes the several intervening structures which stretch across between the osseo-ligamentous boundaries of the pelvis and enclose the irregular outlet of its cavity. Viewed in mesial sagittal section, the floor is seen to be divided by the vaginal slit into two portions, an anterior and a posterior, which have been designated by Hart, respectively, as the pubic and the sacral segments.

The *anterior or pubic segment* appears triangular, being attached to the pelvis in front, and including the structures lying between the symphysis and the vaginal orifice; the urethral and the anterior vaginal walls, together with the dense intervening fibrous tissues, contribute largely to this portion of the floor.

The *posterior or sacral segment* includes the structures between the vaginal orifice and the posterior bony pelvic wall, to the sides of which it is closely attached. The portion of this segment interposed between the vaginal slit and the anus constitutes the important *perineal body* (Fig. 13), whose elastic yet resistant tissues enable the septum to undergo great distention during labor. The perineal body is triangular in sagittal section, and its boundaries are the posterior vaginal wall in front, the anterior wall of the rectum behind, and the integument between the vagina and the anus below. The base of the perineal body measures about 2.6 centimeters, and the height from 30 to 36 centimeters. In addition to the strong bundles of fibro-elastic tissue and involuntary muscle that constitute the body, it is traversed by the muscles which join in the common tendinous perineal centre.

The female *perineum proper*—by which term is to be understood the anterior portion of the pelvic floor included between the ischio-pubic rami as far back as a line drawn through the tubera ischii—corresponds in general with the similarly situated structures in the male, subject to the modification brought about by the mesial cleavage of the parts by the vulvo-vaginal opening. The perineum must be distinguished from the perineal body, the latter including only the limited tissues intervening between the vagina and the anus.

As in the male, so also in the female perineum, the fasciæ constitute important and resistant structures (Figs. 14-16). Of these structures there are three: the deep layer of the superficial fascia (corresponding with Colles'

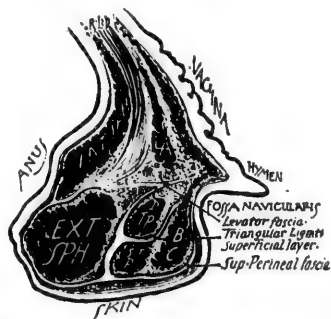


FIG. 13.—Sagittal section of the perineal body, showing its component structures (life size).

fascia), the superficial or inferior, and the deep or superior layer of the triangular ligament. These fascial layers are attached at various levels to the ischio-pubic rami anteriorly and laterally, and converge as they proceed back-

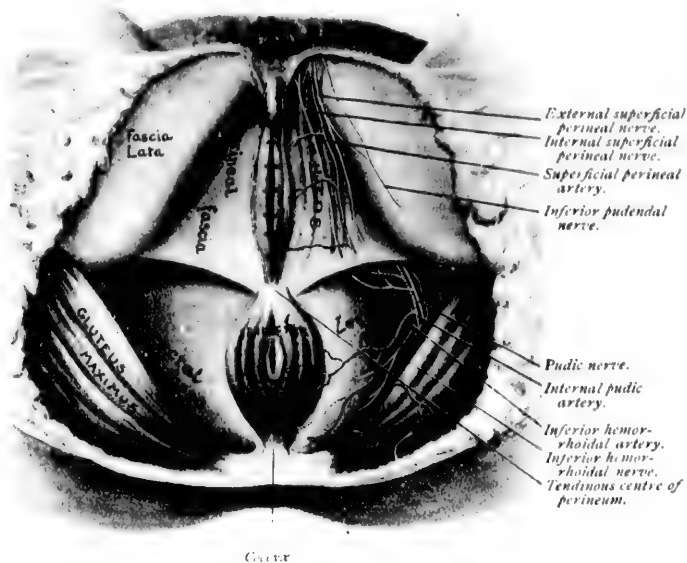


FIG. 14.—Superficial structures of the female perineum (Weisse).

ward to become continuous at the posterior free border of the so-called "perineal shelf," the middle of which marks the perineal centre.

The interval enclosed between the superficial fascia and the superficial or inferior layer of the triangular ligament is divided by the genital orifice into two triangular spaces which together correspond with the *superficial perineal interspace*. The various structures contained within this space include the crura of the clitoris with the associated ischio-cavernosus muscles; the bulbi vestibuli, with the sparingly developed constrictores vaginae, the homologues of the bulbo-cavernosus; the superficial transversi perinaei; the glands of Bartholin; together with the superficial perineal vessels and nerves.

On removal of the skin and the superficial fascia the *ischio-cavernosus* muscles appear as slender bands which arise from the inner surface of the tuberosities and rami of the ischium and the pubic rami, and converge toward the anterior commissure of the genital fissure, to be inserted into the cavernous bodies of the clitoris, these muscles corresponding closely with those of the male except in size, their reduced dimensions agreeing with the diminutive clitoris.

The *bulbo-cavernosus*, or *constrictor vaginae* muscle, is represented by attenuated fibres which pass on either side of the vaginal orifice over the bulbi vestibuli and the slender stalks connecting them with the clitoris. The action of these fibres seems to be largely confined to exerting pressure upon the adjacent

masses of erectile tissue, with little, if any, direct rôle as constrictors of the vagina, compression of this canal being exercised, as already stated, by the contractions of the anterior portions of the levator ani muscle.

The *superficial transversus perinei* muscles closely resemble those of the male, being, however, reduced in size. They arise from the inner surface of the tuberosities and rami of the ischium, in close relation with the origin of the ischio-cavernosi, and extend inward toward the perineal centre, where they blend with the fibres of the sphincter ani and the constrictores vaginæ.

The roof of the superficial interspace is formed by the *inferior* or *superficial layer* of the triangular ligament, the somewhat thickened anterior part of the

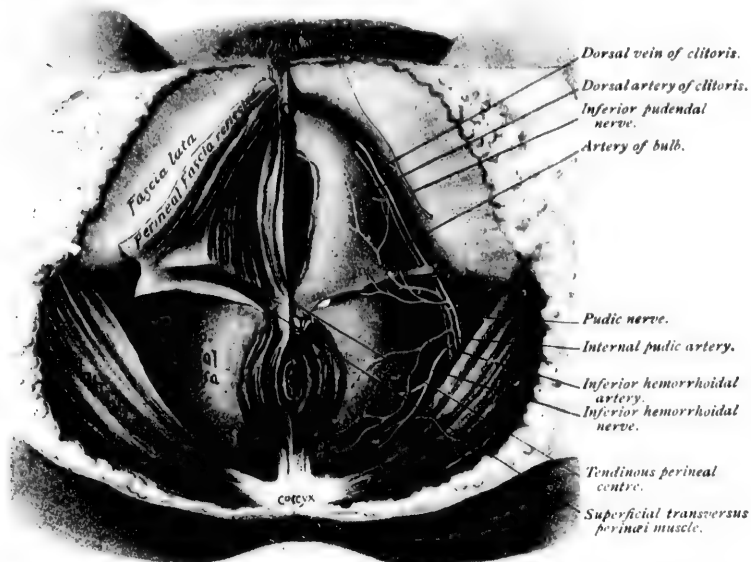


FIG. 15.—Dissection of female perineum: on the left side the perineal muscles are exposed by the reflection of the perineal fascia; on the right side the muscles and the superficial layer of the triangular ligament have been removed, thereby exposing the deep layer of the ligament (modified from Weiss).

deep fascia of the perineum. This layer is attached antero-laterally to the pubo-ischial rami above the line of attachment of the superficial fascia, and stretches almost horizontally across the subpubic arch to the posterior perineal border, where it fuses with the other layers taking part in the perineal ledge.

The *superior* or *deep layer* of the triangular ligament is a resistant fibrous septum which expands inward on each side from its line of attachment along the ischio-pubic rami and constitutes the floor of the anterior extensions of the ischio-rectal fossæ, at the posterior margin of the perineal ledge joining the superficial layer in the common fusion of the fascial layers occurring at that point. This layer may be regarded as a reflection derived from both the obturator and the recto-vesical fascia, since the septum is formed by the union of the contribution given off laterally from the obturator fascia with that sup-

plied mesially by the recto-vesical fascia: this relation is especially evident in frontal sections passing through the ischial tuberosities.

The *deep perineal interspace* lies between the inferior and superior layers of the triangular ligament, and it contains within its wedge-shaped area the urethra and the surrounding venous plexuses, the internal pudic arteries and accompanying veins and deeper nerves, and the fibres of the deep transversus perinaei muscle, here divided by the genital fissure, and represented by thin groups of variable muscular tissue surrounding the urethra.

On removing the skin and fascia, that part of the pelvic floor lying posterior to the perineum proper is divided by a median ridge extending from the

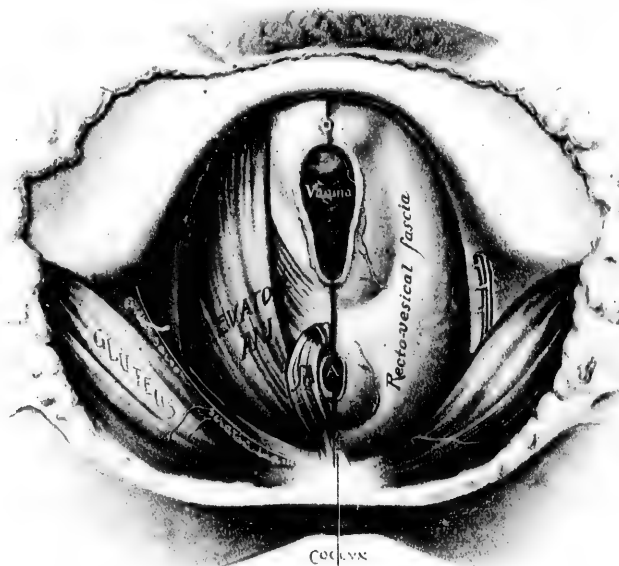


FIG. 16.—Dissection of female perineum, showing the deeper structures after removal of the levator and sphincter and muscles (much modified from Weisser).

perineal centre to the tip of the coccyx, that consists of the lower end of the rectum surrounded by the deep muscular band of the *sphincter ani externus*. This muscle comprises voluntary fasciculi which extend from the perineal centre in front, where they blend with the fibres of the superficial transverse perineal and vaginal constrictor, to the tip of the coccyx behind, enclosing the anus in their course. Superficially the anal sphincter is closely related with the integument, deeply with the levatores ani and the internal sphincter; the muscular tissue of the rectum is closely related to the external sphincter, since numerous bands of the former blend with the encircling fasciculi of the sphincter. Externally the anal sphincter comes in contact in its deeper parts with the tissue occupying the ischio-rectal fossae; the latter extend as two

deeply receding spaces whose superior boundary follows the lower surface of the levatores ani.

The *ischio-rectal fossæ* are continued anteriorly and posteriorly within the pockets situated respectively above the triangular ligament and the sacro-sciatic ligaments. Viewed in sagittal sections passing through these recesses, the

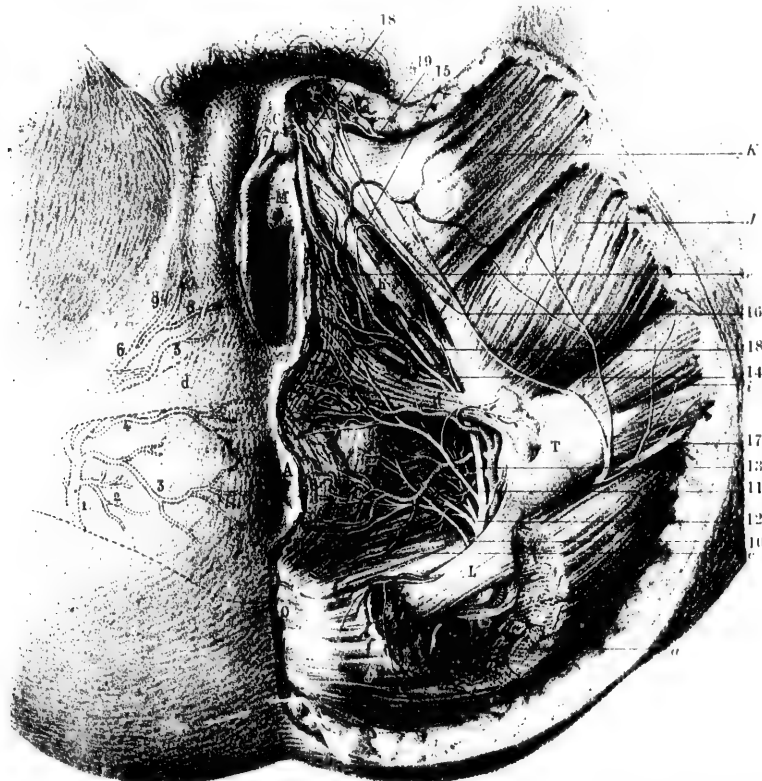


FIG. 17.—Dissection of female perineum, showing superficial blood-vessels and nerves (Savage): *C*, clitoris; *M*, meatus urinarius; *V*, vaginal orifice; *A*, anus; *O*, coccyx; *T*, tuber ischii; *L*, sacro-sciatic ligament; 1, 6, internal pudic artery, giving off its inferior hemorrhoidal (3), cutaneous, and muscular branches (2, 4); 5, superficial perineal; 8, artery of bulb; 7, 9, terminal branches going to dorsum and cavernous bodies of clitoris; 10, pudic nerve; 11, hemorrhoidal and muscular (12) branches; 13, 14, internal and external superficial perineal nerves; 15, communications with inferior pudendal nerve (16); 17, continuation of deep branch of pudic nerve, terminating as dorsal nerve of clitoris (18); 19, terminal twigs of ilio-inguinal nerve; 20, small sciatic; 21, cutaneous branches; *a*, cut surface of gluteus maximus; *b*, sphincter ani; *c*, levator ani; *d*, transversus perinei; *e*, bulbo-cavernosus; *f*, gracilis; *g*, ischio-cavernosus; *h*, expansion of crus clitoridis; *i*, adductor magnus.

ischio-rectal fossa presents an outline, as described by Anderson, not unlike that of an anvil. In frontal sections the fossa appears as an open A-shaped recess except at its extreme ends, where, as just described, the perineal ledge and the sacro-sciatic ligaments close in the space below.

The *blood-vessels* of the pelvic floor include the arterial branches derived

directly or indirectly from the anterior division of the internal iliac, and the venous trunks accompanying the arteries, as well as the venous plexuses occurring in close relation with the vesico-vaginal walls (Fig. 17).

The inferior vesical and the vaginal arteries, together with twigs from the external pudic, supplement the branches derived from the internal pudic, of which the inferior hemorrhoidal and the superficial perineal especially supply the muscular structures connected with the pelvic floor. The superficial perineal artery pierces the superficial fascia and gains the superficial perineal interspace, supplying the contiguous structures and giving off the transverse perineal branch.

The continuation of the internal pudic artery maintains a more deeply situated course, lying along the lateral boundary of the deep perineal interspace between the two layers of the triangular ligament. In this position are given off the arteries of the vestibular bulbs and of the crura of the clitoris. The internal pudic terminates, after piercing the anterior layer of the triangular ligament, as the dorsal artery of the clitoris, from which twigs extend to the corpus cavernosum, the glans, and the prepuce.

The *veins* of the pelvic floor consist of the trunks which closely correspond with the arteries, of which veins the most important are the tributaries of the pudic vein and those which pursue an independent course and take part in the formation of the rich vesico-vaginal and hemorrhoidal plexuses.

The *nerves* supplying the structures of the floor are derived principally from branches of the sacral nerves, either directly or after their formation of the plexus, supplemented by some few filaments from the ilio-inguinal as well as by numerous branches from the neighboring hypogastric plexus of the sympathetic (Pl. 4).

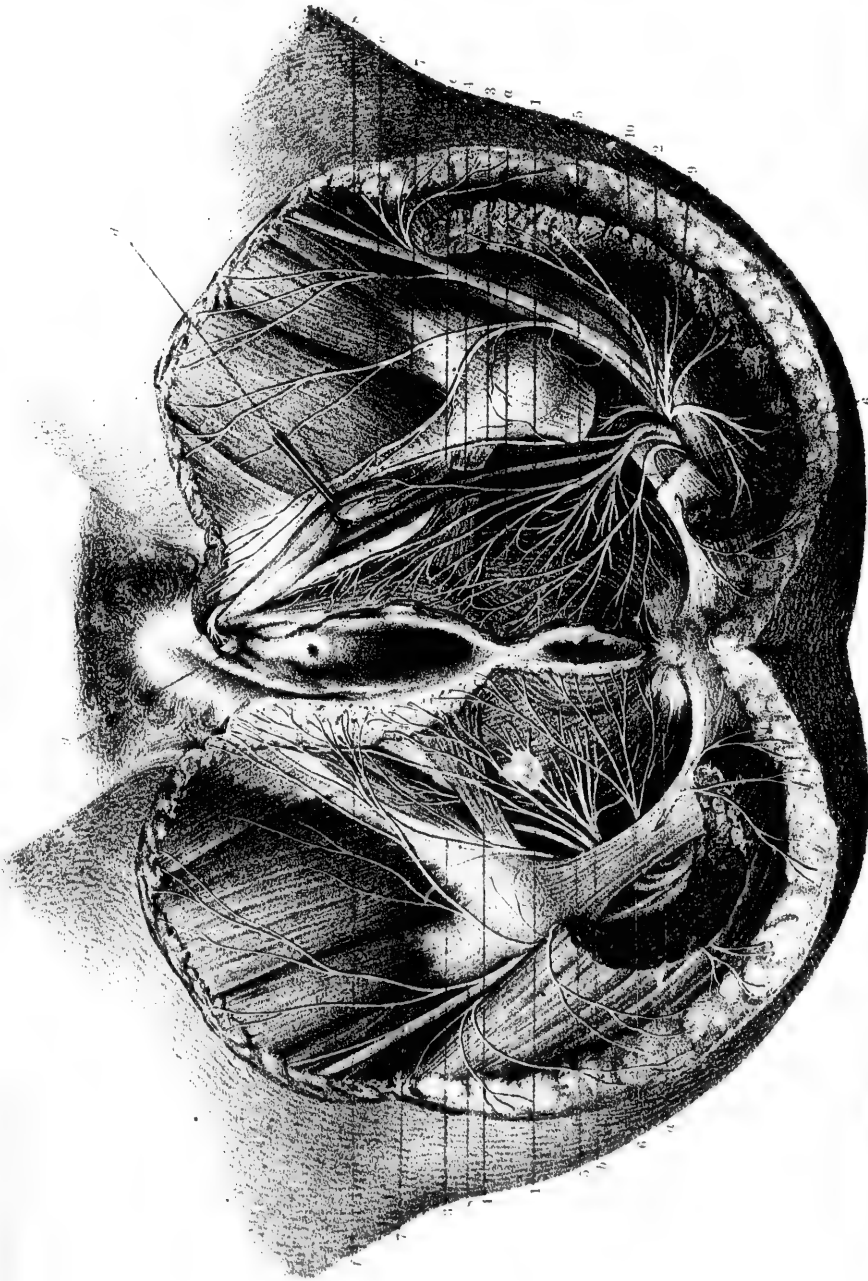
The anterior division of the fourth sacral nerve supplies important muscular structures, including the levator ani, the sphincter ani, and, in conjunction with the fifth sacral, the coccygeus.

The superficial perineal branches of the pudic and the inferior pudendal branch of the small sciatic nerve chiefly provide for the integument and the more superficial structures of the pelvic floor, including the perineal muscles (the ischio-cavernosi, the constrictor vaginae, and the transversi perinei) and the more external portions of the genitalia; the ilio-inguinal contributes filaments to the labia. The termination of the pudic nerve passes forward as the diminutive dorsal nerve of the clitoris. Sympathetic filaments from the hypogastric plexus are additionally distributed to those parts containing abundant vascular tissue.

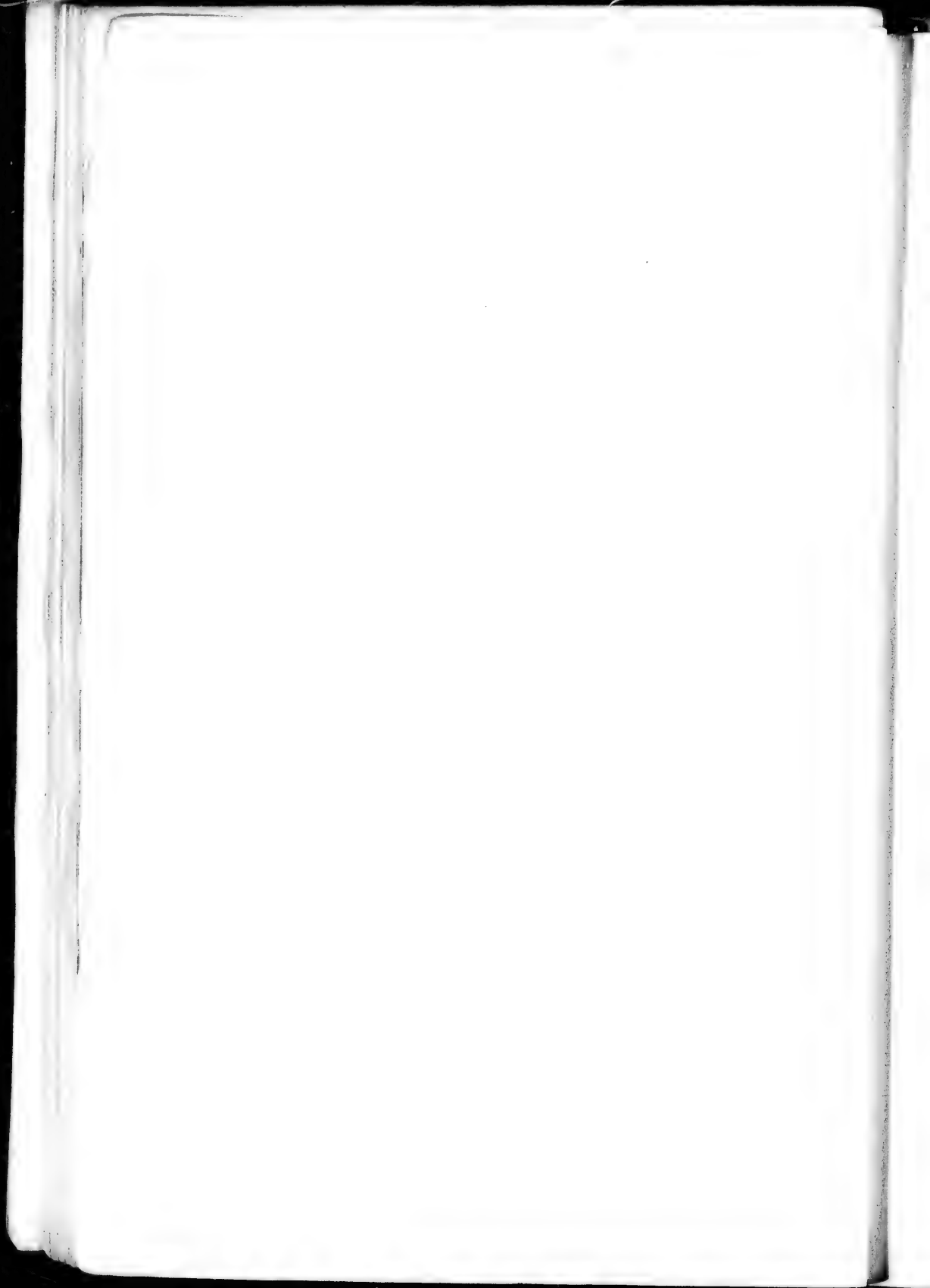
II. ANATOMY OF THE FEMALE GENERATIVE ORGANS.

The structures constituting the female reproductive apparatus consist of three groups—(1) the external, (2) the intermediate, and (3) the internal generative organs.

1. **External organs of generation** (Pl. 5), or the *genitalia*, include the mons veneris, the labia majora and minora, the clitoris, the vestibule with the



Nerves of the female perineum and external genitalive organs (Hirschfeld and Léveillé): 1. Deep branch and continuation of the pudic nerve in its course to the clitoris; 2. superficial or perineal branch, which divides into the external (3) and the internal (4) pudic nerves; 5. muscular branches of superficial perineal nerve; 6. inferior hemorrhoidal nerves; 7. inferior pudendal branch of trunk of pudic nerve; 8. labium majus; 9. labium minus; 10. ischio-cavernosus; 11. transverse perineal; 12. the subcutaneous tissue of the labium majus; 13. the clitoris.



meatus urinarius, and the vaginal orifice. These parts are collectively known as the *vulva* or *pudendum*.

The *mons veneris* presents an eminence surmounting the pubes in advance of the vulva, and is composed of stout integument abundantly supplied with crisp hairs, and a thick cushion of subcutaneous adipose and areolar tissue upon which the rounded contour of the part depends.

The *labia majora*, the homologues of the scrotum in the male, are two conspicuous longitudinal folds of integument extending from the *mons veneris* downward and backward to within about 2.5 centimeters (1 inch) in front of the anus. The elongated fissure included between these folds, the *uro-genital orifice*, occupies almost a horizontal position in the erect posture, and is limited by the *anterior* and the *posterior commissure*, formed by the union of the labia in front and behind. Immediately within the posterior commissure a crescentic fold extends transversely and constitutes the *fourchette*; the space between the latter and the posterior commissure is the *fossa navicularis*.

The labia majora are continuous anteriorly with the *mons veneris*, and are thicker in front than behind; they present the usual appearance of integument, being covered on their outer surfaces with scattered hairs and pigmented epidermis; their protected inner surfaces are more delicate in texture than their outer surfaces, and where least exposed they partake somewhat of the character of a mucous membrane.

The tegmental fold of each labium includes areolar tissue, some involuntary muscle, and a considerable mass of fat which receives the distal end of the round ligament of the uterus. Descent of the ovary into the labium occurs in very exceptional cases, the displaced organ following the round ligament and taking up a position within the labium after traversing the inguinal canal. The labia in the young and well-developed subject are closely approximated and occlude the vaginal orifice.

The *labia minora*, or the *nymphæ*, are two thin diverging folds of delicate skin that lie protected within the greater labia, so that their arched free borders are often completely covered and not visible externally; unless artificially separated their mesial surfaces lie in close contact. The nymphæ are subject to great individual variation in size, in some cases, as conspicuously seen in Hottentot women, reaching excessive dimensions; usually they extend downward and backward from the clitoris (about 3.5 centimeters) along the genital fissure, fading away at the sides of the vaginal orifice. Directly continuous with the labia majora externally, their smooth inner surfaces pass directly into the mucous membrane of the adjacent vestibule, which they closely resemble in appearance and structure. Vascular papillæ and well-developed sebaceous follicles are common to both surfaces of the nymphæ, but sweat-glands, hairs, and fat are wanting. The interior of each fold contains abundant venous spaces, which, in connection with the unstriped muscle present, produce a structure resembling erectile tissue.

The converging and often unsymmetrical labia minora, just before meeting anteriorly, separate into two divisions, the outer and upper leaflets continuing

over the clitoris to unite to form the *preputium clitoridis*, the lower or inner laminae joining below the glands to constitute the *frenum clitoridis*.

The *clitoris*, the homologue of the penis, presents great similarity to the male organ, possessing all the parts of the latter reduced in size and influenced by the absence of the urethra and by the cleft and modified condition of the corpus spongiosum as represented by the bulbi vestibuli.

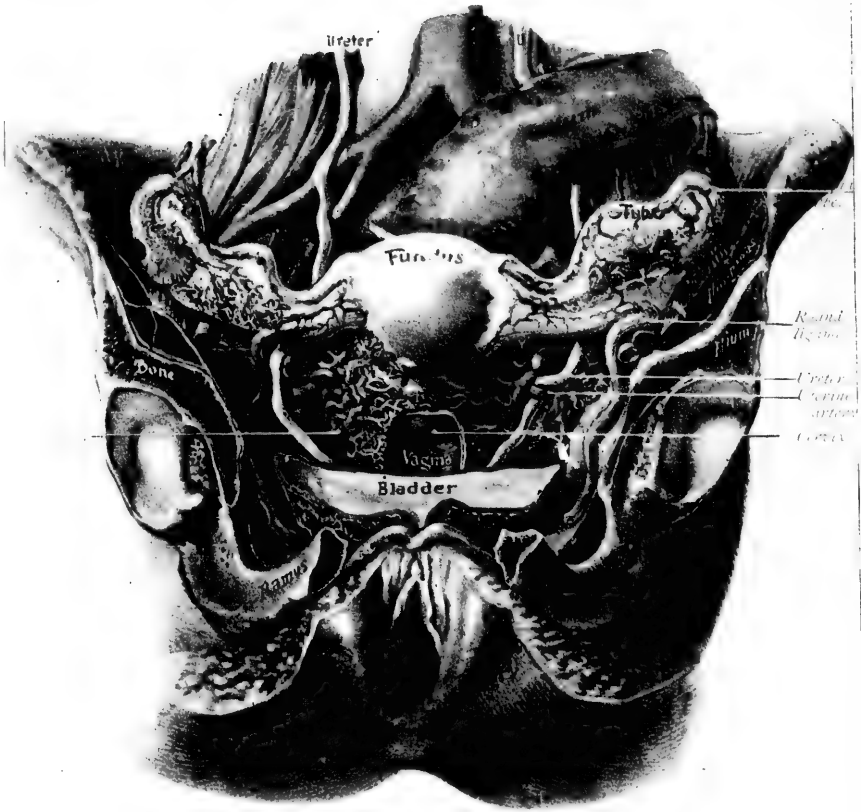
The somewhat laterally compressed body of the clitoris consists of the diminutive *corpora cavernosa*, which diverge behind and are attached by their crura along the pubic and ischial rami, the suspensory ligament aiding in maintaining the position of the organ. In front the cavernous bodies are capped by the rounded *glans clitoridis*, which contains papillae occupied by arterial tufts and the peculiar special nerve-endings, the *genital corpuscles*. The nerves of the clitoris are relatively better developed than the corresponding ones of the penis, the organ being the especial seat of voluptuous sensation. Sebaceous follicles surround the glans, and they are also present in the outer layer of the prepuce, being almost wanting, however, on the glans itself. These follicles secrete substances prone to decomposition and to the production of a peculiar odor. The erectile tissue constituting the diminutive corpora cavernosa and the glans corresponds in structure with similar tissues within the penis. Two small muscles, the ischio-cavernosi or erectores clitoridis, extend from the ischial tuberosities to be inserted in the crura of the clitoris, and correspond with the homologous muscles of the male.

The *vestibule* includes the triangular space lying between the clitoris in front, the vaginal orifice behind, and the nymphæ at the sides. Its smooth mucous surface is broken by the urethral opening, the *meatus urinarius* being situated in the mid-line of the posterior vestibular wall about 2 to 2.5 centimeters (1 inch) behind the clitoris, slightly in advance of the orifice of the vagina.

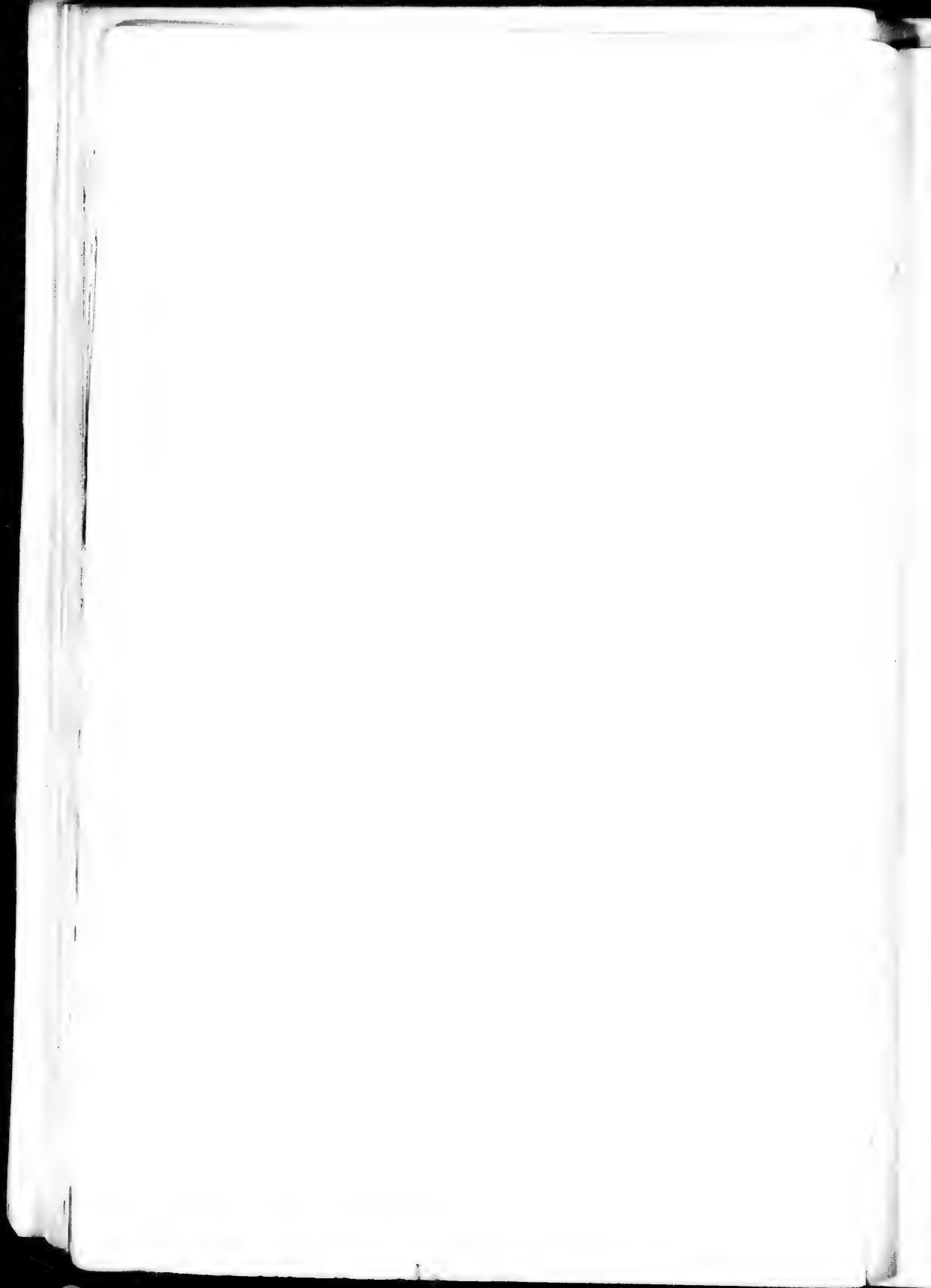
The *urinary meatus* varies in form, but oftenest appears as an ovoid cleft, frequently presenting short irregular lateral branches, surrounded by a border of slightly corrugated elevated mucous membrane, due to the encircling ring of muscular fibres (Pl. 5).

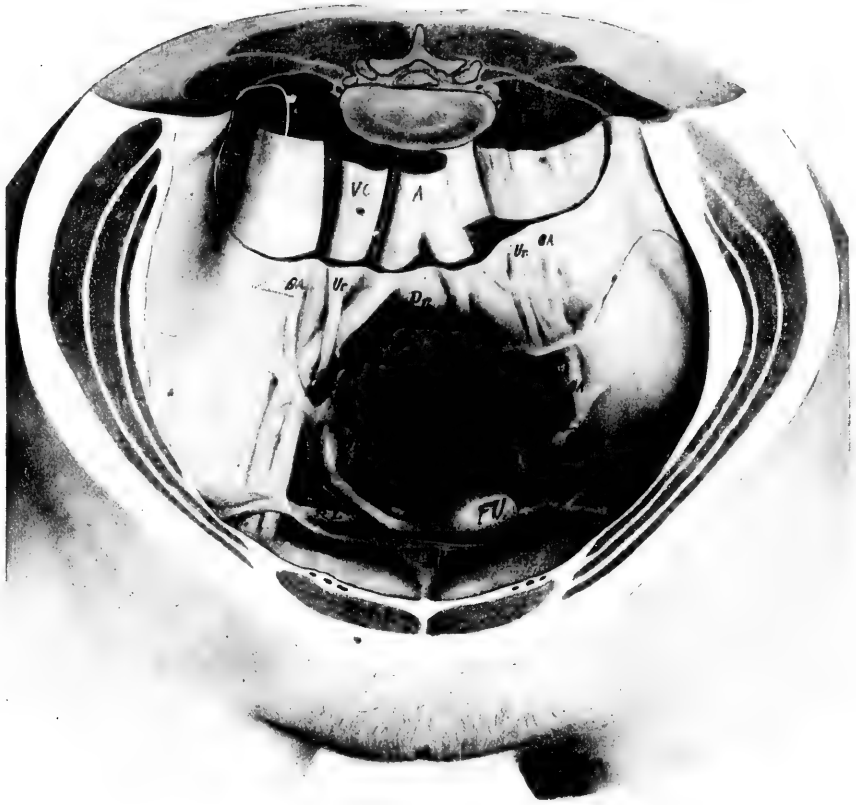
The *bulbi vestibuli* are two elongated leech-shaped masses (about 2.5 centimeters in length) situated on either side of the vestibule a little behind the nymphæ, and attached above to the crura of the clitoris by means of a contracted intermediate portion, the *pars intermediæ*. They are composed principally of close and intricate venous plexuses corresponding with the tissues of the male corpus spongiosum, of which part the bulbi vestibuli must be regarded as the cleft homologue. The constrictores vaginae muscles lie in close relation with the bulbs, and by their contractions, as during sexual excitement, compress the venous channels and render the tissue turgid and erect.

The *glands of Bartholin*, the homologues of Cowper's glands, are two round or oval yellowish bodies (about 1 centimeter in diameter) which lie on either side of the lower part of the vagina. These bodies are less deeply situated than the corresponding structures in the male, being contained within

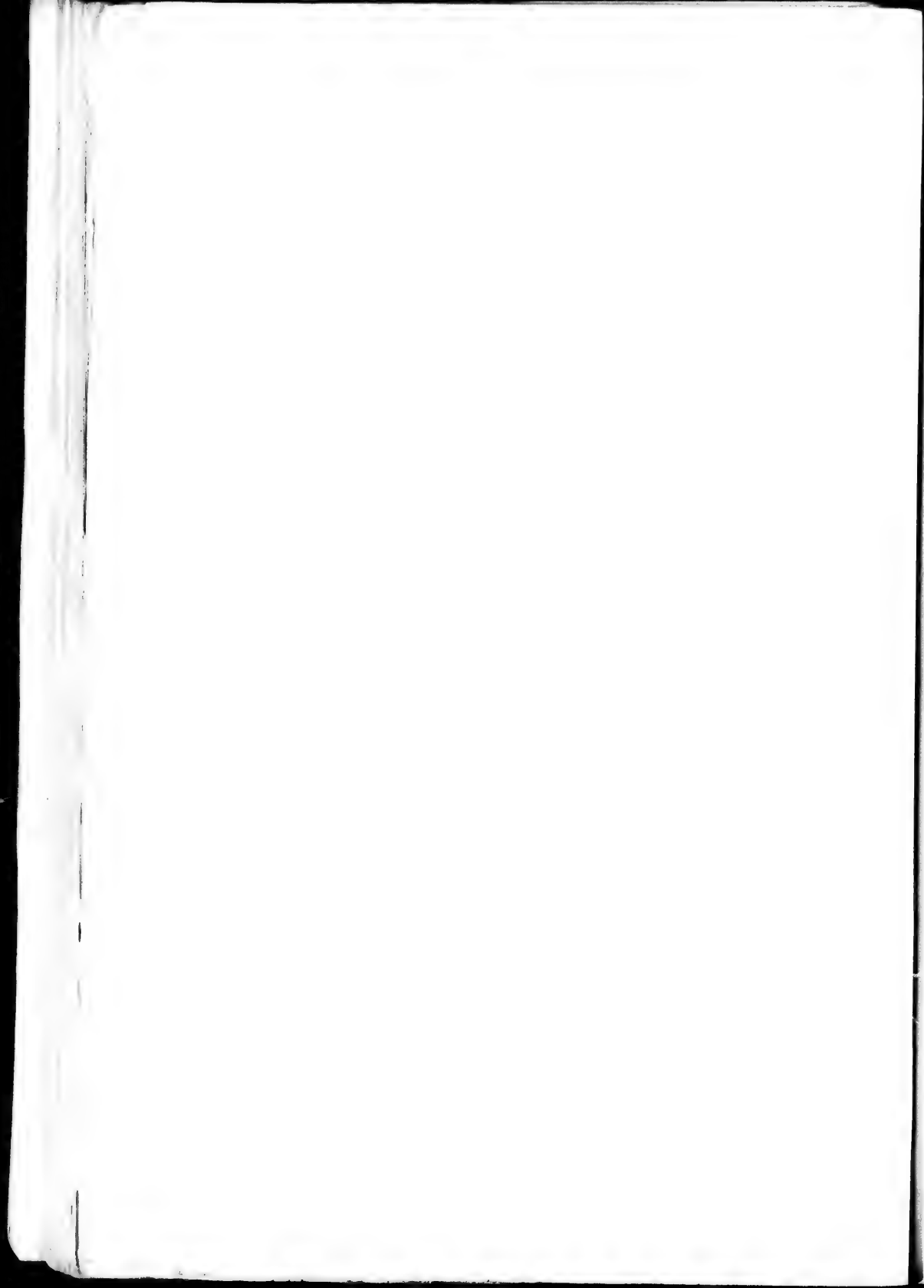


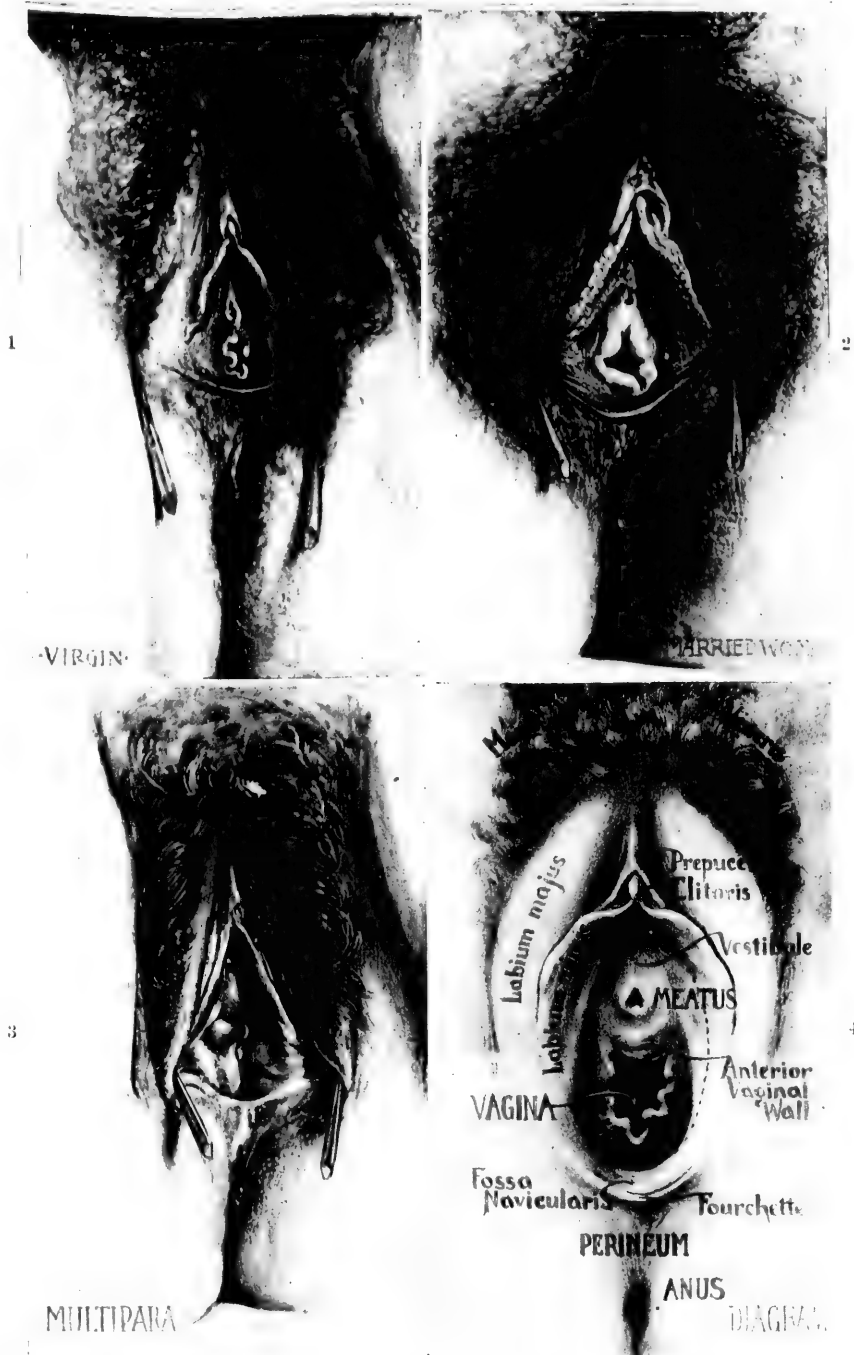
Blood-vessels of the pelvis (Bourget and Jacob): the anterior part of the pelvis has been removed, and the bladder and the anterior vaginal wall have been partially cut away. The uterus is drawn up and the Fallopian tubes are displaced into the iliac fossae.



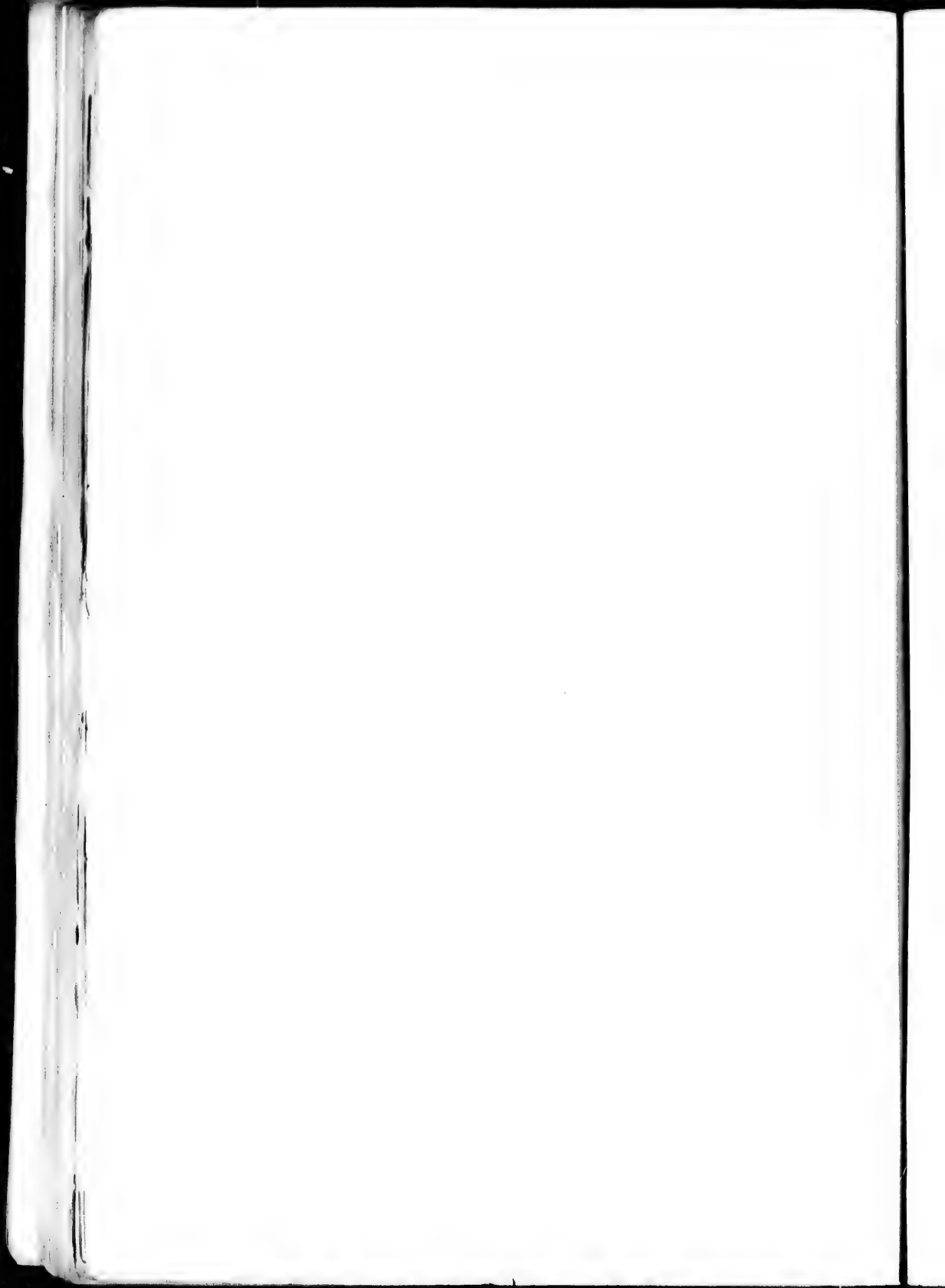


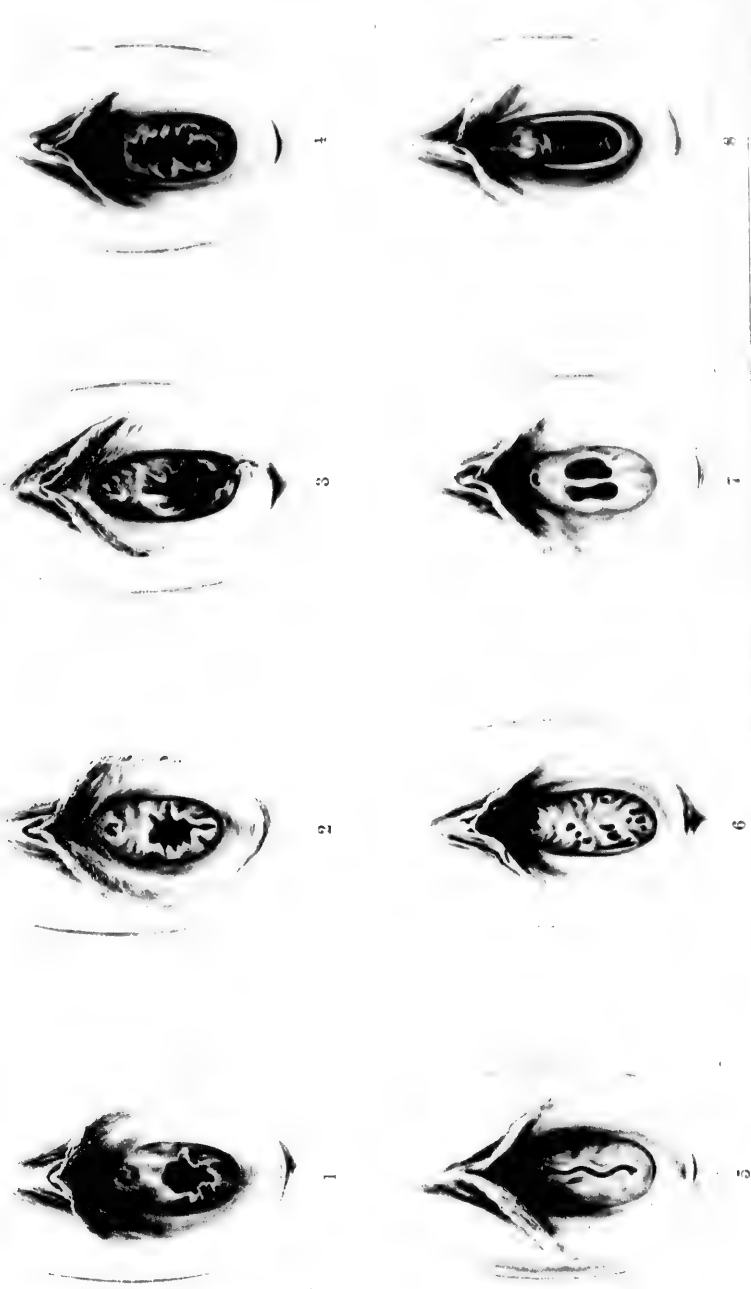
Pelvic organs *in situ* of a young woman of sixteen years: seen from above after careful removal of the intestines without disturbing the relations: A, abdominal aorta; VC, inferior vena cava; Ps, psoas magnus; Ps, promontory of sacrum; R, cut rectum; D, pouch of Douglas; U, body of uterus; FU, fundus of uterus; B, bladder; O, ovary; T, Fallopian tube; RL, round ligament; Ur, ureter; O.A., ovarian artery (redrawn from Waldeyer).



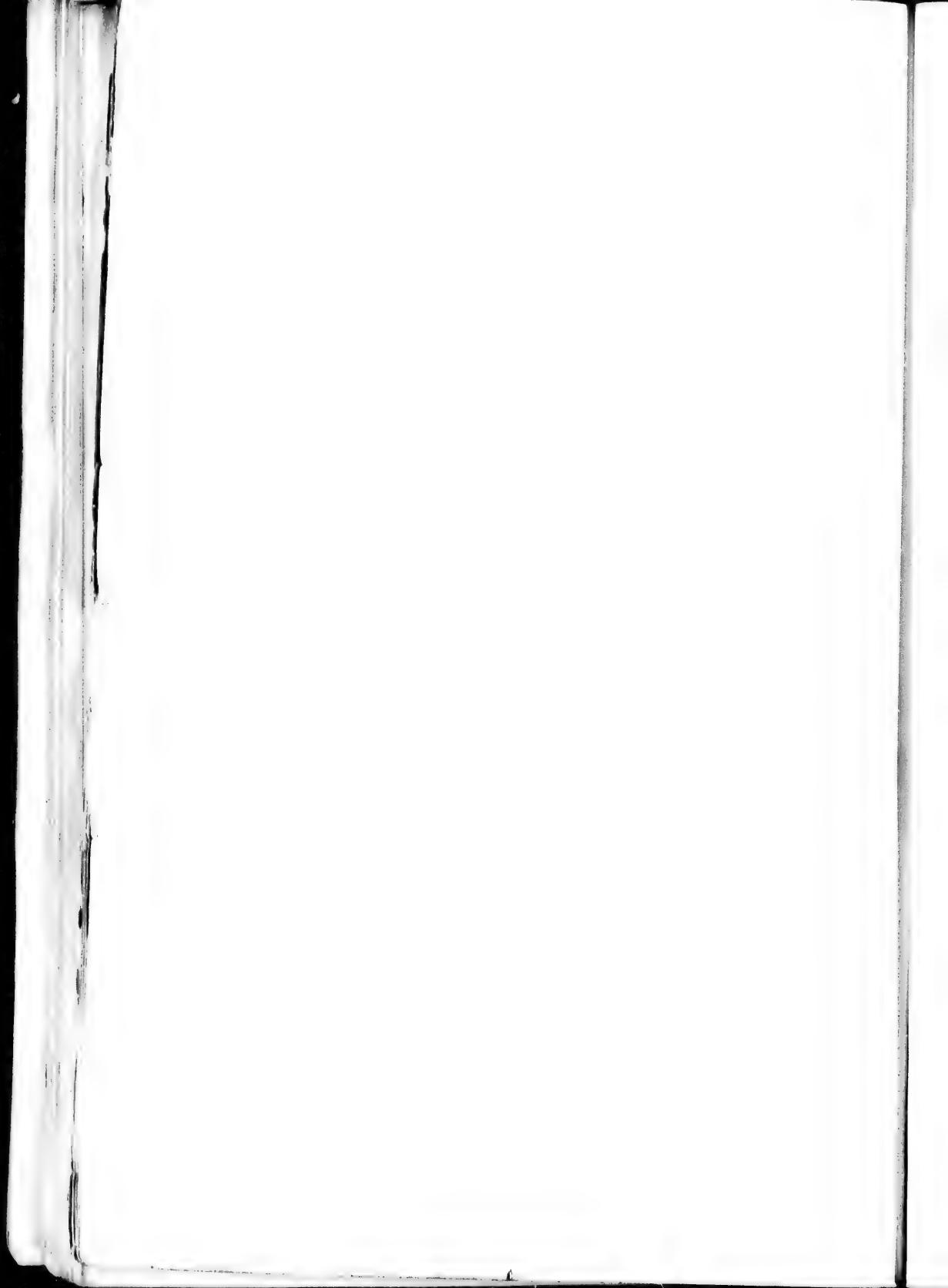


1. Virgin hymen. 2. Characteristic hymen and fourchette of a married woman; large wrinkled labia minora and prepuce. 3. Multipara, showing remnant of hymen, pouching anterior and post-vaginal wall, scar in perineum, large labia majora. 4. Diagram on a different scale from the preceding figures.





VARIETIES OF HYMEN: 1. Virgin hymen, commonest form (annular); 2. hymen after coitus; 3. after delivery; 4. fimbriate; hymen; 5. hymen with narrow slit; 6. crescentic form; 7. hymen with septum; 8. horseshoe form.



the superficial perineal interspace, and not between the two layers of the triangular ligament. They are muco-serous racemose glands, and pour their secretion upon the mucous membrane by long slender ducts which, after an oblique course, open into the vestibule just external to the vaginal orifice.

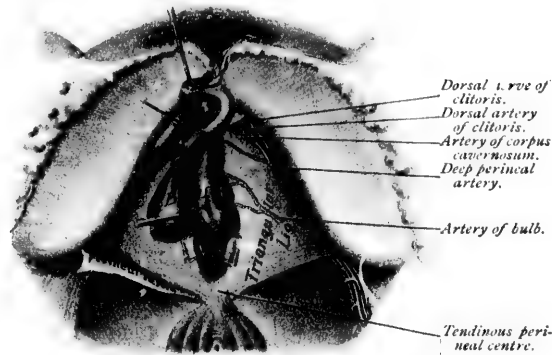


FIG. 18.—Dissection of female perineum, showing the vestibular bulb and the clitoris (Weisse).

The *hymen* consists of a thin, usually crescentic duplicature of mucous membrane, strengthened by fibrous tissue, stretched across the posterior part of the vaginal opening, which it partly occludes. The hymen varies greatly in form and in extent, at times being represented by a slight semilunar fold

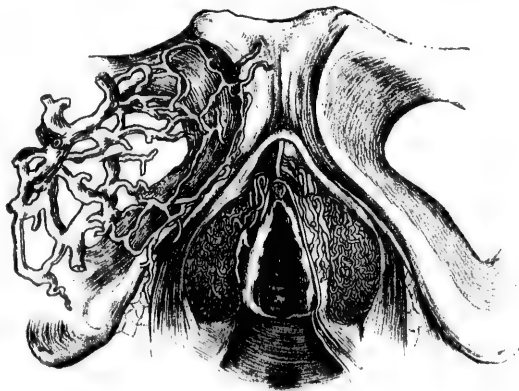


FIG. 19.—Erectile structures of the female genitalia, particularly the highly vascular bulb of the vestibule (Kobelt).

whose concavity looks upward toward the pubes, at other times forming almost a complete and imperforate membranous septum. The variations in the shape and extent of the fold and its orifice include the circular, cleft-like, cordiform, cribriform, and other types, well illustrated on Plate 6. Rupture of the

hymen usually, but by no means necessarily, occurs during the first sexual intercourse; in rare cases the septum persists until the event of parturition. In women who have borne children the orifice of the vagina is surrounded by irregular papillary elevations, the *carunculæ myrtiformes*: these are the remains of the ruptured hymen, but are usually present only after labor has taken place, since, as established by Schroeder, the rent hymen is converted into these eminences as the result of the pressure incident to childbearing, and not to coitus.

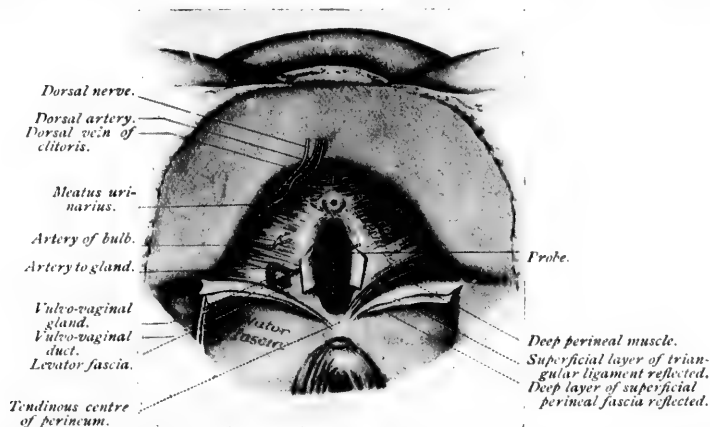


FIG. 20.—Dissection of female perineum, showing structures within the deep interfascial perineal interspace; the vulvo-vaginal glands, however, belong to the superficial space, but are shown resting on the deeper structures (Weisse).

The *female urethra* (Fig. 21) is short, being only about 4 centimeters in length, and lies beneath the symphysis pubis, firmly imbedded within the anterior vaginal wall. It descends from the neck of the bladder to the vestibule almost vertically, presenting usually, however, a slightly marked double or sigmoid curve, or at least a curvature, forward. Its vestibular orifice, the *meatus urinarius*, is indicated usually by an elevation of the mucous membrane situated from 2 to 2.5 centimeters behind the clitoris. The meatus marks the most constricted part of the canal, the average diameter of which is about .6 centimeter. Owing to the elastic character of its tissues and to the yielding nature of the surrounding structures, the female urethra is capable of great distention, a matter of importance in examination of the bladder.

The walls of the urethra comprise a mucous, a submucous, and a muscular layer. The mucosa is covered by stratified squamous or transitional epithelium directly continuous with that of the bladder; tubular glands occur near the vesical end of the canal, where the mucous membrane is soft and spongy. Skene has called attention to the existence of two small tubes (from 10 to 20 millimeters in length) which lie within the muscular walls of the female urethra and which open by minute orifices situated about 3 to 4 millimeters within or above the meatus. These tubes probably represent the remains of Gärtner's duct derived from the fetal Wolffian duct.

The submucous stratum contains much elastic tissue and a rich venous plexus. The muscular tissue of the bladder is continued over the urethra as an inner longitudinal and an outer circular layer, in addition to which the tube receives an investment between the layers of the triangular ligament from the compressor urethræ or deep transverse perineal muscle. The numerous blood-vessels and nerves of the female urethra are derived from the same sources as those of the vagina.

The *female bladder*, relatively broad and capacious, bears important relations to the vagina and the uterus. When empty and relaxed the organ lies entirely within the true pelvis, behind the pubes and usually to one side; the fundus is then greatly flattened out and somewhat indented, so that the cavity of the bladder and the urethra together appear Y-shaped in section (Fig. 22), the widely-separated hinder limb and the corresponding posterior vesical wall lying against the upper part of the vagina and the lower segment of the uterus;

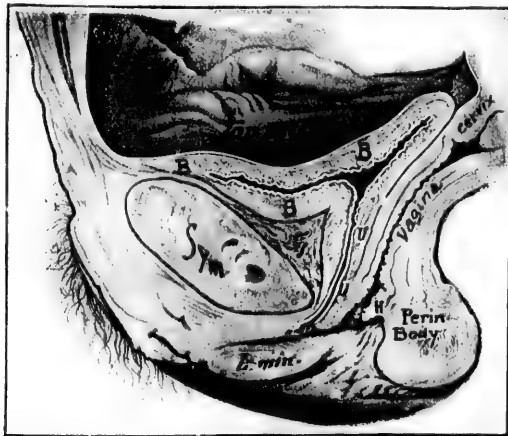


FIG. 21.—Sagittal section, showing relations and form especially of the bladder, urethra, and vagina (Hart): U, U, urethra; B, B, bladder.

sometimes, however, the empty organ is strongly contracted, the cavity of the bladder then presenting a slit-like lumen. Maximum distention carries the bladder, together with the peritoneum, well above the pubes, with the consequent tendency to backward displacement of the uterine fundus.

The Female Ureter.—The ureter in the female (Pls. 7, 8) presents peculiarities in its relations within the pelvis that deserve notice. After the usual relations of the abdominal portion of its course—proceeding downward and inward upon the psoas muscle and its fascia, being crossed by the ovarian vessels, and crossing the iliac vessels about 1.5 centimeters below the division of the common iliac artery—the ureter passes into the true pelvis in front of the sacro-iliac synchondrosis, thence upon the obturator internus muscle and its fascia toward its termination, running beneath the root of the broad ligament.

About opposite the origin of the vesical and uterine arteries from the

internal iliac, the ureter forms a sweeping curve which is most pronounced where the uterine artery crosses the ureter, about on a level with the os externum. The ureter crosses the uterus at a point closely corresponding with the position of flexure of the uterine body upon the cervix, here lying between the vesical venous plexus laterally and the utero-vaginal venous plexus and the uterine artery internally.

The lower part of the ureter passes at first at the side of the upper third of the vagina; it then reaches the vesico-vaginal septum, within which it lies for 1.5 to 2 centimeters before entering the bladder-wall.

The ureter does not extend lower than about the middle of the anterior wall of the vagina; as it rests directly upon the latter, it is enclosed for a



FIG. 22.—Mesial section, showing the relation of the viscera in their normal position (Dickinson).

short distance (about 1 centimeter) within a distinct fibrous sheath continuous with the bladder-wall (Waldeyer).

The course of the ureter within the vesical wall is obliquely downward and inward for a distance of about 1.5 centimeters. The lower part of the tube, from its investment by the above-mentioned sheath to its termination, is cylindrical in form, in contrast with the remaining flattened portions of the canal.

2. Intermediate Organ.—The Vagina.—The musculo-membranous canal of the vagina forms the intermediate tract connecting the internal and the

external organs of generation. Piercing the pelvic floor with its lower end, it lies chiefly within the cavity of the pelvis, in relation with the bladder and the urethra in front and with the rectum behind, the *vesico-vaginal* and the *recto-vaginal septa* intervening. The axis of the vagina (Fig. 23), while corresponding in general with that of the pelvic cavity, resembles that of the urethra and the rectum in presenting a double or S-like curvature. The axis of the lower third of the vagina corresponds closely with the plane of the pelvic brim; that of the upper two-thirds lies parallel with the axis of the lower third of the rectum, forming almost a right angle to the axis of the anal extremity of the gut.

The two principal vaginal walls, the anterior and the posterior, ordinarily lie in contact except at the sides, where the lumen of the canal laterally

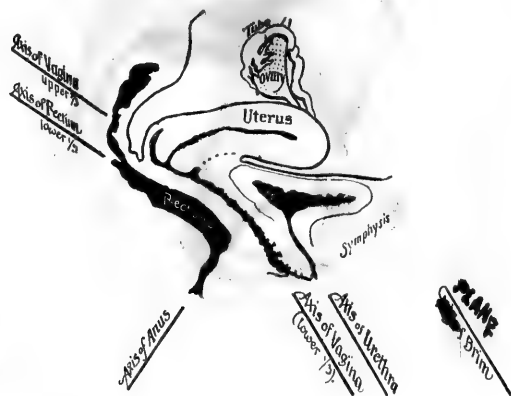


FIG. 23.—Sagittal section of female pelvis, showing axis of the vagina.

expands. In cross-section, therefore, the vaginal passage under normal conditions appears H-shaped (Fig. 24); when distended it is club-shaped, being more capacious above than below, where the entrance marks the least diameter.

The shorter *anterior wall* (Fig. 25) extends from the vaginal entrance to the apex of the corresponding utero-vaginal recess or *anterior fornix*, and measures about 6.5 centimeters, or about $2\frac{1}{2}$ inches; seen from behind, this surface appears triangular in its general form, the base being above, corresponding with the greater superior diameter of the canal. The anterior wall is very conspicuously marked by transverse *rugæ* (Fig. 26), which are especially prominent in the virgin; an additional vertical fold, the *anterior column*, is

present at the lower part of the passage, where, also, this wall, distinctly thicker than its fellow, is most robust.

The *posterior wall*, much the longer, extends from the vaginal orifice or the hymen to the apex of the deep *posterior fornix* (Fig. 25) or retro-cervical fossa; it lies in front of the anterior rectal wall, with which, throughout its lower two-thirds, it is united by areolar tissue. The posterior wall measures about 9 centimeters, or about $3\frac{1}{2}$ inches, in length, being broader above than below; its superior third receives an imperfect covering of the peritoneum which forms the most dependent portion of the anterior wall of Douglas's pouch. While distinctly less corrugated than the anterior wall, the pos-

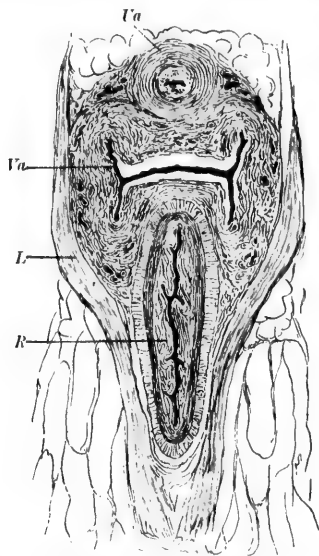


FIG. 24.—Section illustrating the characteristic form of the vaginal cleft (Henle): *Ua*, urethra; *Va*, vagina; *L*, levator ani; *R*, rectum.



FIG. 25.—Sagittal section, showing vaginal walls and relation of cervix uteri (Skene).

terior surface in the virgin possesses numerous transversely disposed rugæ as

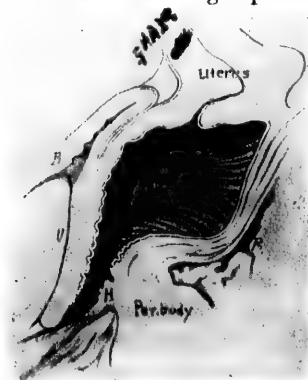


FIG. 26.—Sagittal section of vagina of a virgin, showing rugous condition of walls and enlarged upper extremity (Hart).



FIG. 27.—Sagittal section of vagina of a multipara, one-half natural size (Hart).

well as a vertical, and sometimes double, posterior column. Subsequent to the dilatation incident to parturition the vaginal rugæ are much less conspicuous

(Fig. 27), those on the posterior wall often almost entirely disappearing, leaving the somewhat pouched surface relatively smooth; the folds of the anterior wall are retained to a much greater extent.

In *structure* the walls of the vagina consist of a mucous membrane, a muscular coat, and a fibrous tunic. The *mucosa* is covered by a thick stratified, squamous epithelium, and possesses numerous papillæ. The rugæ include within their structure not only the tissues of the mucosa, but also bundles of involuntary muscle and large veins. True *glands*, if found at all, are represented by a few sparingly distributed tubular structures within the upper part of the vaginal mucous membrane, the acid secretion which bathes its surface being the product of the general mucosa. The deepest part of the mucous membrane, that corresponds with the *submucous layer*, is succeeded by the *muscular coat*, composed of an inner circular and an outer longitudinal stratum of unstriped muscle.

The *fibrous tunic* consists of a dense coat, rich in fibro-elastic tissue, which is derived as a prolongation of the recto-vesical fascia and materially contributes to the strength of the vaginal wall. The lower extremity of the canal is encircled by a thin plane of muscular fibres constituting the constrictor vaginæ muscle, and is closely attached to additional bands derived from the levator ani.

Blood-vessels and Nerves.—The vascular and nervous supplies of the vagina are very generous. The *arteries* are derived from the vaginal, the internal pudic, the vesical, and the uterine branches of the internal iliac. Corresponding *veins* return the blood to a large extent, in addition to which the vaginal plexus surrounds the lower part of the canal and communicates freely with the neighboring vesical and hemorrhoidal plexuses. The urethral plexus around the upper portion of the urethral canal receives the dorsal veins of the clitoris. Within the submucosa large and plentiful venous radicles, together with bands of involuntary muscle, give this layer the character of erectile tissue.

The *lymphatics* of the vagina constitute two groups, those from the lower and the upper portions of the canal. The former join the lymphatics of the external genital organs and end within the superior or oblique set of inguinal glands; the latter, together with the vessels from the lower part of the uterine body and the cervix, proceed outward within the broad ligament, joining with the lymphatics from the oviduct and the ovaries, and terminate in the lumbar glands.

The *nerves* of the vagina are contributions from both the sympathetic and the cerebro-spinal system. The branches of the former are derived from the inferior hypogastric plexus, those of the latter from the fourth sacral and the pudic nerve. The sympathetic fibres are largely distributed to the vascular tissues.

3. Internal Organs of Generation.—*The Uterus.*—The *uterus*, the thickened and specialized segment of the generative tube for the reception, the retention, the development, and the final expulsion of the product of conception, in its mature but virgin condition is a slightly pyriform body whose thick, dense walls enclose a narrow, cleft-like cavity. The organ lies within the pelvis,

held by supporting peritoneal folds and muscular bands extending between the bladder in front, the rectum and the sacrum behind, and the pelvic walls at the sides; the most dependent portion of its lower and smaller segment, the *cervix*, projects within the upper part of the vagina.

The *virgin uterus* (Figs. 28, 29) measures about 7.5 centimeters (about 3 inches) in length, 4 centimeters (about 1½ inches) in its greatest width, and



FIG. 28.—Anterior view of virgin uterus, showing relations of cervix to corpus uteri and reflection of peritoneum at isthmus.

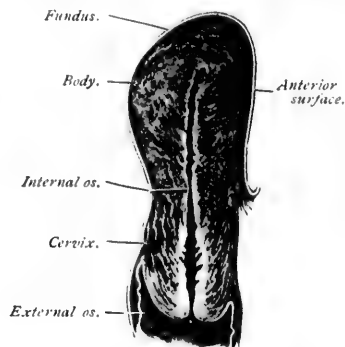


FIG. 29.—Sagittal section of virgin uterus, showing position of os internum, fusiform character of the cervical canal, and relations of the peritoneum.

about 2.5 centimeters (1 inch) in thickness; of the entire organ, approximately three-fifths belong to the body and two-fifths to the neck, the latter being relatively much longer in the nulliparous adult than after pregnancy has

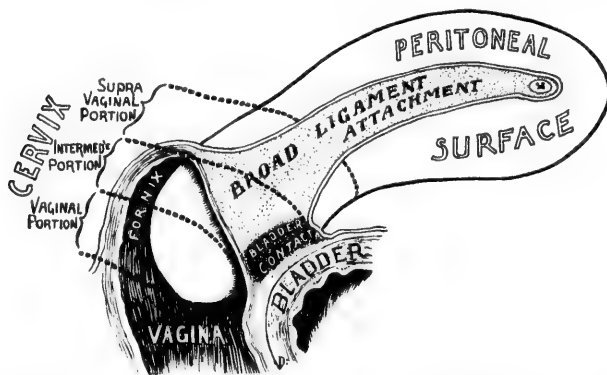


FIG. 30.—Diagram illustrating the relations of the uterus to the vagina, bladder, and peritoneum.

occurred. The division of the uterus into body and neck is indicated externally by the constricted *isthmus uteri*, which is situated about midway in the organ; internally, however, this boundary is uncertain, since the contours of the cervical mucous membrane gradually pass into those of the general uterine lining.

The pyriform *body* is almost flat on its anterior surface, but posteriorly is distinctly convex; its superior and anterior arched border is thick and rounded, and passes over into the slightly convex lateral borders at the superior angles. The upper part of the organ, including its superior arched border, constitutes the *fundus* and is completely invested with peritoneum. The serous covering of the anterior surface extends only as far as the isthmus, whence it is reflected to the neighboring vesical wall. The peritoneum on the posterior wall is complete, since the serous membrane is prolonged downward and backward about 2.5 centimeters beyond the cervix upon the posterior wall of the vagina before passing to the rectum. The lateral borders mark the attachment of the broad ligaments.

The *cervix*, slightly spindle-form in general outline, may be divided into three portions or zones (Fig. 30), the supravaginal, the intermediate, and the intravaginal. The first of these zones occupies the upper half of the cervix, extending somewhat farther forward along the anterior surface, where it comes in relation with the bladder, than posteriorly, where covered by the peritoneum of Douglas's pouch. The intermediate portion includes the zone of vaginal attachment, hence it is narrow and oblique, extending higher behind than in front. The intravaginal segment, or *os uteri*, projects within the vaginal canal in such manner that its axis is directed toward the posterior wall, and it

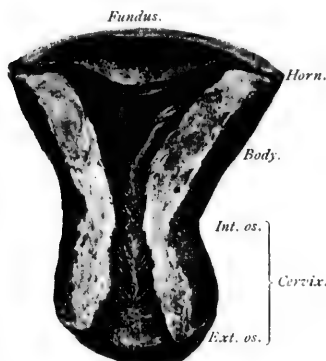


FIG. 31.—Cavity of uterus displayed by removal of anterior wall.



FIG. 32.—Virgin uterus laid open, showing the rugous condition of the cervix.

presents the transversely oval orifice of the cervical cavity, bounded by the rounded and prominent anterior and posterior lips or labia, the anterior of which is somewhat the thicker and shorter. The proportion between the body and the cervix varies with age: in the young virgin adult the uterus is about equally divided between these segments; in early life the cervix greatly preponderates over the imperfectly developed fundus; while after childbirth the fundus never returns to its former size, always remaining enlarged and nearly twice its original length (Fig. 31). With the advent of old age the entire organ suffers marked atrophy.

The *cavity of the virgin uterus* is very narrow, the apposition of the anterior and posterior walls of its body reducing the space to little more than a longitudinal cleft, as seen in mesial sagittal sections (Fig. 29). Viewed



FIG. 33.—Casts of the cavities of uteri of various ages and conditions (modified from Hagemann): 2, 3, from multipare of eighteen and twenty-four years; 4, from a woman of forty-eight years who had one child fifteen years previous.

from in front, the uterine cavity is triangular, the expanded base extending between the orifices of the oviducts, and the apex corresponding with the inner

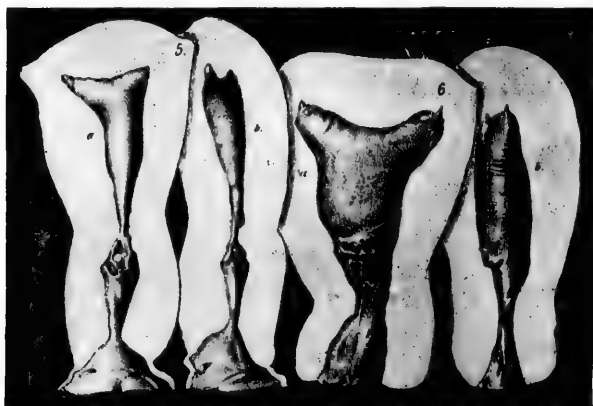


FIG. 34.—Casts of the cavities of uteri from (5) a nullipara of sixty-eight years, and (6) from a parous subject of seventy years (modified from Hagemann).



FIG. 35.—Front and profile views of casts of the uterine cavity of a newborn infant (modified from Hagemann).

opening of the cervical canal. On account of the encroachment of the uterine walls, the cavity of the uterus between the angles presents concave outlines.

The *cavity of the cervix* is fusiform, being of larger diameter at its middle than at the ends, the *os internum* and the *os externum*. The *os internum*, which marks the point of greatest contraction, possesses a lumen of circular outline; the

os externum before pregnancy appears as a narrow, transversely placed orifice. The anterior and posterior walls of the virgin cervical canal exhibit conspicuous plications depending upon the arrangement of the bundles of muscular tissue; these rugæ are arranged as principal longitudinal folds, the anterior and posterior columns, from which secondary plications extend laterally. These corrugations collectively form the *arbor vite* (Fig. 35) of the uterus, being best marked in the virgin and being effaced by repeated parturitions.

Structure.—The uterine walls include a mucous, a muscular, and a serous coat. The *mucosa* consists of a tunica propria of delicate bundles of fibro-elastic tissues covered by an epithelium composed of a single layer of ciliated columnar cells. Numerous wavy tubular depressions, the *uterine glands* (Fig. 36), are also lined by the ciliated epithelium. Since a submucous layer is

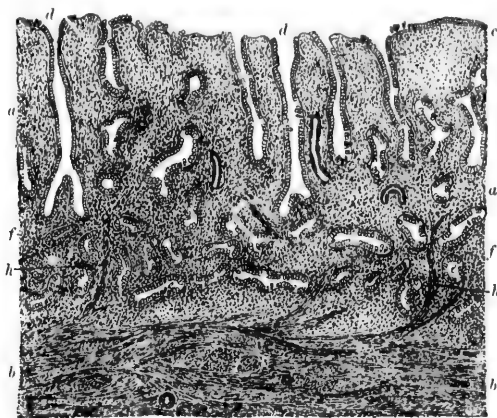


FIG. 36.—Section of human uterus, including mucosa (a) and adjacent muscular tissue (b); c, epithelium of free surface and tubular uterine glands (d); f, deepest layer of mucosa, containing fundi of glands; h, strands of non-striped muscle penetrating within the mucosa (Piersol).

wanting, the blind and often forked extremities of these glands abut directly upon the muscular tissues.

The *cervical mucosa* differs from that of the body, being thicker and firmer, supplied with papillæ, and covered with stratified squamous epithelium within the lower third. In the upper half or two-thirds of the cervix the epithelium is ciliated columnar, similar to that of the body. In addition to the tubular follicles, the representatives of the usual uterine glands, numerous short, widely-expanded mucous crypts lie within the cervical mucosa. Retention of the secretion of some of these mucous sacs often takes place, the resulting greatly distended cysts appearing as translucent yellowish vesicles, the so-called *ovule Nabothi*. In its meagre supply of glands the mucous membrane of the lower part of the cervix still further resembles that of the adjacent vaginal surface.

The *muscular coat* (Fig. 37) of the uterus consists of bundles of unstripped muscle (Fig. 38) separated by bands of connective tissue and surrounding vascular channels. Although irregularly arranged, the muscular tissue is disposed

in three general strata—an inner, a middle, and an outer layer. The inner layer,

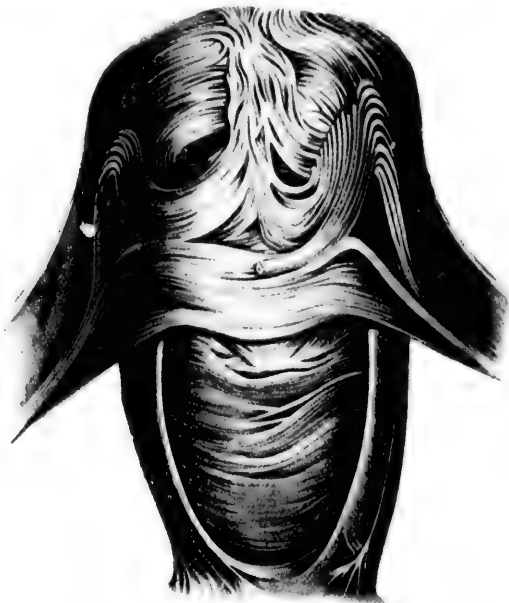


FIG. 37.—Arrangement of uterine muscle, as seen from in front after removal of serous coat (Hélie).

composed principally of longitudinal bundles, is in direct contact with the mu-

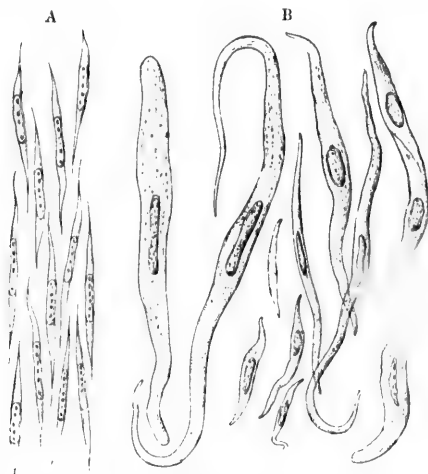


FIG. 38.—A, isolated muscle-elements of the non-pregnant uterus; B, cells from the organ shortly after delivery (Sappey).

cosa, and is sometimes regarded as belonging to that layer, as being a hypertrophied

muscularis mucosæ. The middle layer is most robust, and forms the greater part of the muscular coat, consisting chiefly of bundles having a general circular disposition. This layer is also distinguished by the numerous large venous channels enclosed between its bundles, hence the name, *stratum vasculare*. The outer layer includes both circular and longitudinal bundles, the latter predominating and lying in close relation with the superimposed serous coat. Many bundles of the outer layer pass into the broad ligaments; some of these enter the round ligaments and accompany the areolar tissue and the blood-vessels composing these structures toward the groin, while others extend along the oviducts and ovarian ligaments. Muscular bands pass also from the uterus into its supporting folds, the sacro-uterine band being particularly robust. The musculature of the cervix is distinguished by greater regularity in its arrange-



FIG. 39.—Broad ligaments viewed from the posterior surface, showing uterus, oviducts, and ovaries; the natural position of the latter has been disturbed in consequence of the separation of the supporting attachments.

ment, which includes a distinct inner longitudinal, a middle circular, and an outer longitudinal layer.

The *serous coat* of the uterus comprises the usual constituents of the peritoneum.

Ligaments.—The supporting apparatus of the uterus consists of two parts, the folds of peritoneum and the muscular bands which extend from the uterus to adjacent structures. The first group includes two anterior, two lateral, and two posterior ligaments; the second group, the so-called "muscular ligaments," is represented by the utero-inguinal, the utero-ovarian, the utero-pelvic, and the utero-sacral muscular bands; the last of these, the utero-sacral, are included within the posterior peritoneal folds; the remaining ones lie between the layers of the lateral or broad ligaments.

The *anterior ligaments* are two inconspicuous semilunar peritoneal folds which pass between the upper part of the cervix on each side to the adjacent posterior surface of the bladder, and bound the *vesico-uterine* pouch.

The *lateral* or *broad ligaments* (Fig. 39), as implied by their name, are two wide duplicatures of peritoneum that extend from the sides of the uterus and the vagina to be attached to the lateral wall and the floor of the pelvis. Each of these broad folds presents four borders, the superior, the inferior, the internal, and the external; of these but one, the superior, is free, the others being intimately joined with neighboring parts. The *superior* or *free border* encloses the oviduct, whose tortuous course it follows as far as the fimbriated end; at this point the plication diverges toward the pelvic wall and forms the *infundibulo-pelvic ligament*, which fold connects the end of the tube with the side of the pelvis and transmits the ovarian vessels. The *inferior border* is united with the recto-vesical fascia covering the levator ani, the subperitoneal tissue intervening between its diverging lamellæ giving transit to blood-vessels and nerves as well as to the ureter. The *internal border* is attached to the sides of the uterus and the vagina, the blood-vessels and muscular bands passing into the tissue of the broad ligament between its divergent layers. The external border comes in relation with the obturator fascia and affords transit for the uterine vessels and the round ligament.

The broad ligaments enclose within their serous folds structures of importance (Fig. 40). Along their unattached superior margins lie the oviducts; a

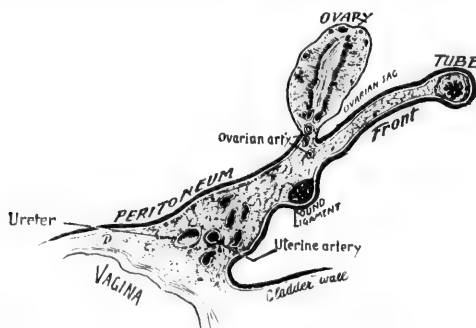


FIG. 40.—Diagrammatic section of broad ligament, showing relations of the contained structures.

little lower and anteriorly are situated the round ligaments; posteriorly, the ovaries and their muscular attachments; numerous blood-vessels, nerves, and lymphatics, together with the parovarium, the paroöphoron, and the utero-pelvic bundles of involuntary muscles which pass from the uterus and the vagina to the obturator fascia, are additional structures included within these folds.

The *round ligaments* (Fig. 41) are two flattened cord-like bands, from 10 to 12 centimeters in length, attached to the upper segment of the uterus in front of the oviducts, and extending from this point downward, outward, and forward, winding round the deep epigastric artery on the inner side of the external iliac artery, to the internal orifices of the inguinal canals, through which they pass

to blend with the tissues of the labia majora. The round ligament possesses a covering of peritoneum, and in the young subject a funnel-like depression marks



FIG. 41.—Dissection of the pelvic organs, showing the relation of the abdominal parietes to the round ligaments and the bladder: 1, 3, the obliterated hypogastric arteries; 2, the urachus (Bourguery and Jacob).

a tubular extension of the peritoneal sac along the cord as it leaves the abdomen; this extension constitutes the *canal of Nuck*, and is homologous with the pro-

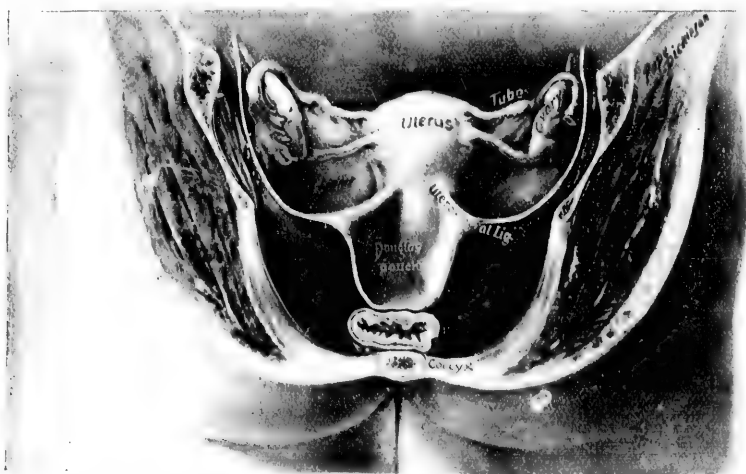


FIG. 42.—Posterior view of the uterus and ovaries, with the peritoneal folds composing the broad ligaments and the utero-rectal fossa (modified from Hodge).

cessus vaginalis of the male. It is usually obliterated after early life, but may persist, and, in rare cases, be accompanied by an abnormally descended ovary,

which then occupies a position within the labia, behind the peritoneal sac. In structure the round ligament consists of bundles of connective tissue and blood-vessels, together with plain muscular tissue derived from the uterus.

The *posterior* or *recto-uterine ligaments* are two peritoneal folds which pass backward from the cervix and the upper part of the vagina to become continuous with the serous covering of the second portion of the rectum. The deep fossa included between these folds laterally, the uterus anteriorly, and the rectum posteriorly constitutes the *pouch of Douglas* (Fig. 42), which is frequently occupied by coils of small intestine. Between the layers of the posterior ligaments flat bands of involuntary muscular tissue, the so-called *utero-sacral*



FIG. 43.—Sagittal section of female pelvis, showing the utero-sacral ligaments suspending the uterus, also the pubic segment part of the supporting apparatus of the uterus (Dickinson).

ligaments (Fig. 43), extend on each side from the highest segment of the cervix to the sides of the sacrum, at the level of the sacro-iliac juncture. These bands, among the most important parts of the supporting apparatus of the uterus, are intimately related with the muscular coat of the rectum, which tube they encircle near the union of its first and second parts; laterally and anteriorly they are in close relation with the pouch of Douglas.

The *position* of the normal uterus (Fig. 22) during life has received consideration from many investigators, whose conclusions, however, have been so contradictory and uncertain that almost every situation of the organ has in turn been regarded as representing its normal relation. This discrepancy has been due in large measure to the methods of examination employed, which include observations on the cadaver, bimanual examination of the pelvic organs of the living subject, and frozen sections of the parts shortly after death.

The examination of the viscera in the cadaver in the usual way, even when carried out with skill and precaution, must necessarily be untrustworthy

as to the details of topographical relations, on account of the uncertainty introduced by reason of the unavoidable post-mortem alterations and inevitable distortions affecting the organs. The apparent exactness of the method of frozen sections likewise is unfavorably influenced by the relaxation after death of the supporting bands which during life maintain the positions of the organs; it follows, therefore, that the testimony of sections cannot be accepted as unimpeachable evidence as to relations during life, since the relations preserved are only those existing at the time of fixation; likewise, the possibility of encountering the effects of pathological changes in frozen sections must also be appreciated. The testimony of the most competent and careful investigators points to the conclusion that the most valuable and trustworthy observations as to the normal position of the uterus are to be gathered from careful examinations of properly preserved bodies, where the organs have been hardened *in situ* immediately after death. The results of such investigations closely agree with the opinions of the most expert observers derived from repeated examinations on the living subject.

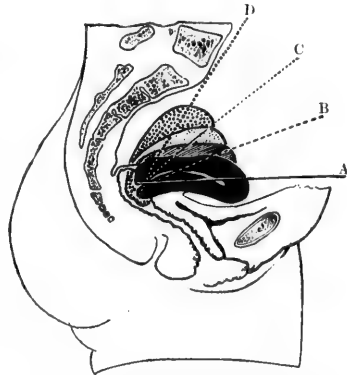


FIG. 44.—Diagrams illustrating range of variation in position of uterus as affected by distention of the bladder (Van de Warker).

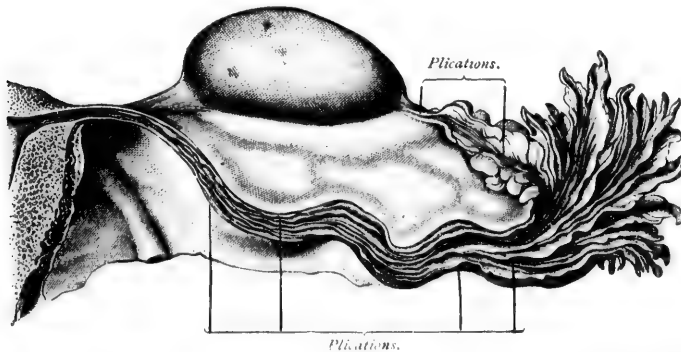


FIG. 45.—Longitudinal section of Fallopian tube, exposing the complicated longitudinal plications of the mucosa which expand into the fimbriae (Sappey).

In accordance with the conclusions based on such grounds, the normal uterus most probably occupies a position almost horizontal in the upright posture: the fundus, usually slightly to one side of the mid-line, rests on the bladder and is directed forward and upward, while the cervix forms a slight deflection with the axis of the uterine body and looks down and backward against the

posterior vaginal wall. Whether the uterus lies most frequently to the right or to the left of the mid-line is still in dispute; the latter position, to the right, is probably most usually encountered (His), although the opposite condition, as shown on Plate 8, is certainly not uncommon. The topographical relations between the uterus and the bladder are so close that the position of the womb is materially influenced by vesical distention. The range of variation in the position of the normal uterus is diagrammatically represented by Figure 44.

The *oviducts*, or *Fallopian tubes* (Fig. 38), the representatives of the un-united portions of the fetal Müllerian ducts, extend from the superior rounded angles of the uterus, within and along the free upper margin of the broad ligaments for a distance of from 10 to 12 centimeters, to the vicinity of the ovaries, where each terminates in an expanded funnel-shaped orifice, the *pavilion* or *infundibulum*, surrounded by a series of fringed processes, the *fimbriae* (Fig. 45). Examined in carefully-preserved specimens retaining the typical position of parts, the tube at first passes outward closely related with the pelvic floor; it then turns upward along the attached anterior border of the ovary, when, after reaching the upper pole of the gland, the tube bends downward upon the free posterior border and the inner surface of the ovary (Figs. 22, 41), which are by this means partly masked (Waldeyer).

The oviduct commences at the inner attached extremity as a narrow tube, the *isthmus*, about 2 millimeters in diameter; during its further slightly



FIG. 46.—Portion of broad ligament stretched to show the pavoarium (p) lying between the folds and consisting of the head-tube and cross-tubules (Gegenbaur).

wavy course it gradually gains in width until the tube measures 4 millimeters or more, when it again becomes somewhat narrowed, but beyond the ovary it rapidly expands into the ampullae and the fimbriated extremity (Fig. 46). The lumen of the tube is narrowest at its inner end, where it opens into the cavity of the uterus by a minute orifice, the *ostium internum*, which scarcely admits a bristle; the diameter of the canal gradually increases until

it presents, just before its final expansion into the fimbriated orifice, a distinct opening, the *ostium abdominale* (from 4 to 6 millimeters in width), situated at the bottom of the cleft-like depression leading from the attached border of the fimbriated expansion.

Structure.—The oviduct consists of three coats—an inner mucous, a middle muscular, and an outer serous. The *mucous* lining presents numerous longitudinal folds (Fig. 47); these become more conspicuous within the infundibulum, where they greatly increase in size and complexity and terminate in the sinuous border of the fimbriae. All parts of the canal, including its expanded

outer end, are clothed by a single layer of ciliated columnar cells, whose ciliary current sweeps from the fimbriae toward the uterine end of the tube. At the free edge of the fimbriae the columnar epithelial cells give place to the low, plate-like elements of the peritoneum covering the exterior of the tube. Glands are absent within the mucous membrane of the oviduct. The *muscular tunic* includes a principal inner layer of circularly-disposed bundles of involuntary muscle and a slightly-developed outer layer of longitudinal bundles. The

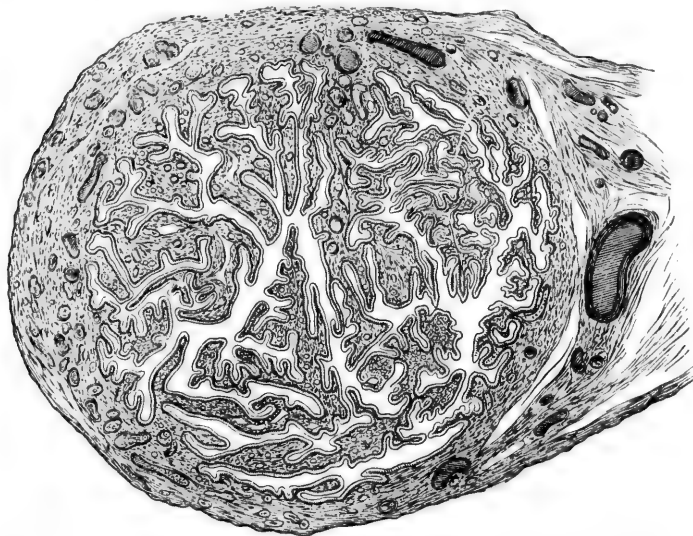


FIG. 47.—Transverse section of Fallopian tube, showing the complicated arrangement of the longitudinal plications which are here cut across (Martin).

serous coat consists of the fibro-elastic stroma and endothelium of the general peritoneal investment contributed by the broad ligament.

The *blood-vessels* of the oviducts are branches from the ovarian and the uterine arteries and the corresponding veins, the arteries possessing an unusually tortuous course. The *nerves* are derived from the ovarian and uterine plexuses, and consist of both medullated and pale fibres.

The Ovaries.—Each ovary presents a flattened ovoid mass, somewhat almond-shaped, which appears as an appendage of the posterior surface of the broad ligament (Fig. 39), to which the organ is attached by its straighter anterior border. The dimensions vary with the individual as well as with the condition of functional activity; the longest diameter usually measures about 3.5 centimeters, the width about 2 centimeters, and the thickness a little over 1 centimeter. The weight of the ovary is ordinarily between 6 and 7 grams, the right being commonly slightly heavier and larger than the left ovary.

The anterior border alone is attached; the arched posterior border and the broad surfaces are free and are covered with modified peritoneum, the *germinal*

epithelium, directly continuous with the serous covering of the broad ligament. The position of the ovaries *in situ* (Pl. 8; Figs. 22, 41) and during life, at least before the permanent displacement attending pregnancy has taken place,

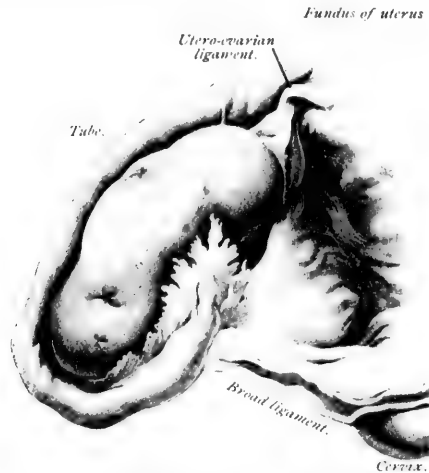


FIG. 48.—Ovary (natural size), with the Fallopian tube in relative position, of a woman twenty-three years of age (Sutton).

is probably such that the long axes of the organs are nearly vertical (Waldeyer, His, Cunningham) and correspond closely with the sagittal plane, so that the broader surfaces may be spoken of as internal and external rather

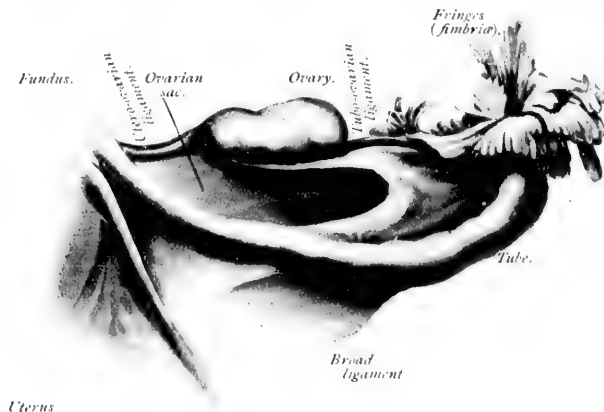


FIG. 49.—Ovarian sac or recess on the posterior aspect of the broad ligament (modified from Richard by Bland Sutton).

than as anterior and posterior. The position of the fundus uteri is a factor of moment in determining the ovarian axis, since, as pointed out by His, the

ligament.
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pull of the uterus when not occupying a mesial position predisposes to increased obliquity of the ovarian axis of the opposite side.

The smaller and lower end of the ovary, or the *uterine pole*, points toward the uterus, with which it is united by means of the fibro-muscular bands consti-

Fundus of uterus.

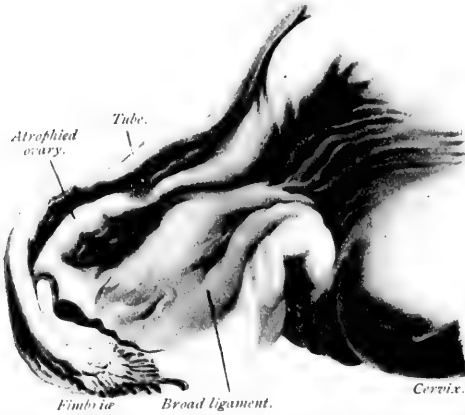


FIG. 50.—Ovary and tube (natural size) of a woman, of sixty-eight years (Sutton).

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tuting the *ovarian ligament*; the upper and blunter end, or the *tubal pole*, after being embraced by the arching oviduct, receives the lower border of the fimbriated extremity of the Fallopian tube, and is further connected to the wall of the pelvis by the *ovario-pelvic fold* of the peritoneum. The ovary lies within a peritoneal recess, the *fossa ovarii* (Claudius), which occupies the posterior part of the side wall of the pelvis, usually bounded by the internal iliac artery and the ureter behind and the obturator vessels and nerve in front.

Both the anterior and posterior borders of the gland, as well as its inner surface, are closely related to and are partly masked by the curves of the oviduct.

Structure.—The ovary is divided into the *cortex* and the *medulla* (Fig. 52), the boundaries of which are conventional and not sharply defined. The *cortex* includes the peripheral zone, containing the Graafian follicles and the ova, and occupies approximately the outer third of the organ. The *medulla* embraces the remaining central portions of the organ, in which the blood-vessels, entering through the hilum, are conspicuous.

The bulk of the organ consists of the *ovarian stroma*, a peculiar form of connective tissue in which lie imbedded the Graafian follicles, distinguished by the great number of its spindle-cells. These cells are especially closely packed in the cortex immediately beneath the surface covered by the germinal epi-

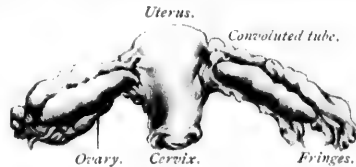


FIG. 51.—Uterus, tubes, and ovaries of a child (Sutton).

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thelium, in which situation they constitute a layer of greater density than the adjacent stroma, to which the name *tunica albuginea* is applied; this stratum, however, is only a condensation of the ordinary stroma tissue, and is not an independent envelope.

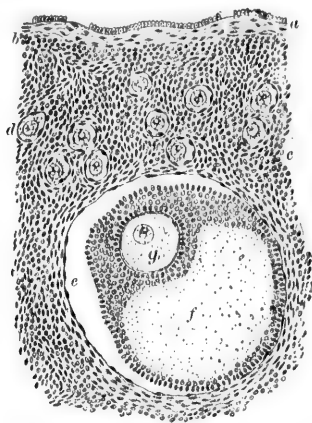


FIG. 52.—Section of human ovary, including cortex: *a*, germinal epithelium of free surface; *b*, tunica albuginea; *c*, peripheral stroma containing immature Graafian follicles (*d*); *e*, well-advanced follicle from whose wall membrana granulosa has partially separated; *f*, cavity of liquor folliculi; *g*, ovum surrounded by cell-mass constituting discus proligerus (Piersol).

The Graafian follicles, the most important constituents of the cortex, are exclusively limited to this part of the ovary, where they occur in all stages of development. The least mature follicles consist of ova surrounded by a single layer of flattened cells, the progenitors of the membrana granulosa. Among the immature follicles are others in



FIG. 53.—Ovary with mature Graafian follicle about ready to burst (Ribemont-Dessaignes).

various stages of more advanced development, where the ova are encircled by two or more rows of polygonal cells which by their division give rise to the numerous elements lining the follicle.

Both the ova and the surrounding cells are derivatives of the *germinal epithelium* covering the free surface of the ovary, from which they dip into the stroma as cylindrical cell-cords. With the increase in size which accompanies their development the Graafian follicles pass toward the inner limits of the cortex bordering on the medulla, where they undergo further enlargement; after a time their diameter includes almost the entire cortex, and extends from the medulla to the surface of the ovary, the position of the follicle becoming evident on the free surface as a distinct projection (Fig. 53), marking the point at which the final rupture of the sac and the escape of the ovum take place.

The mature Graafian follicles appear as clear, slightly elongated vesicles 8 to 12 millimeters in diameter; they are defined from the surrounding tissue by a condensed layer of the ovarian stroma, the *theca folliculi*. Within the theca follows the *membrana granulosa*, consisting of many layers of small polyhedral epithelial cells. At one point the membrana granulosa presents a thickening which encloses the ovum and constitutes the *discus proligerus*. The cells of the discus next the ovum lie vertical to its surface, forming a radial zone, the *corona radiata*. Within this layer lies the sexual cell, the ovum, which will be considered more fully in the section relating to its development.

The formation of new follicles continues only for a short time after birth;

ovisacs are then most numerous, the entire number contained within the two ovaries of the child being estimated at over seventy thousand. In view of the unquestionably large number of follicles in very young ovaries, and the relatively small proportion of ova which reach maturity, the degeneration of many follicles after attaining a certain development seems certain. The atrophic remains of such degenerating Graafian follicles continually encountered point conclusively to the fate of a large contingent.

The *medulla* contrasts with the cortex by its looser structure and the number and size of its vascular, and particularly its venous, canals. A considerable amount of involuntary muscle is intermingled throughout the fibrous tissue separating the blood-vessels. Irregular groups of polyhedral cells are encountered between the fibrous bundles of the medulla; these elements, the *interstitial cells*, represent the remains of atrophic parts of the fetal Wolffian bodies.

On the escape of the ovum, surrounded by the cells of the discus proligerus, the ruptured and partly collapsed follicle becomes filled with blood poured out from the torn vessels of the walls of the follicle. Subsequent changes lead to the conversion of the follicle into a *corpus luteum*. This characteristic structure is formed by the ingrowth and rapid proliferation of the vascular tissue of the follicular wall, spindle-shaped connective-tissue cells and large cells containing yellow pigment, *lutein*, being the most active elements in the process. The history of the *corpus luteum* is materially affected by the occurrence of pregnancy, since, instead of being almost entirely absorbed within a few weeks, as is the rule with the ordinary bodies, when fertilization takes place they persist until after the end of gestation. It is usual, therefore, to distinguish the *corpus luteum of pregnancy*, or the *corpus verum*, from the *corpus luteum of menstruation*. The mode of growth is identical in both, the stimulus of impregnation leading usually to excessive development. The primary blood-clot occupying the ruptured follicle becomes invaded by the enlarged and thickened wall, which soon becomes corrugated, the plications encroaching upon the clot and increasing to such an extent that the folds crowd against one another and eventually form an irregular broad envelope surrounding the remains of the central clot. When pregnancy occurs the processes are continued beyond their usual length, resulting by the end of the first month in the production of a mass from 12 to 20 millimeters in diameter, characterized by a brilliant yellow peripheral zone surrounding a lighter centre. This condition is succeeded by the gradual reduction and cicatrization of the central area and the lighter tint of the now greatly corrugated broad outer belt. By the end of gestation the white nucleus constitutes about one-third of the entire corpus luteum, which has already become somewhat smaller (10 to 13 millimeters) than at the sixth month. After delivery absorption progresses rapidly, but for some months later the position of the corpus is distinguishable. The characteristic yellow color of these bodies is due to the presence of a peculiar pigment, *lutein*, and not merely to disintegrated blood.

The peculiarities distinguishing the corpus luteum of pregnancy from that of menstruation have long been regarded as of especial significance as supplying positive evidence that pregnancy has taken place. While the presence of the typical yellow body must be regarded as strongly indicative of such condition, the occasional encounter in the ovaries of undoubted virgins of corpora lutea possessing the characteristics of those of pregnancy, as recorded by



FIG. 54.—Ovaries of two virgins, showing large corpora lutea, resembling those of pregnancy (Hirst).

Hirst (Fig. 54), should lead to some reservation and to a demand for corroborative evidence in the acceptance of these bodies as infallible signs of the existence of pregnancy.

The Parovarium.—The *parovarium*, the *epoöphoron*, or the *organ of Rosenmüller*, consists of a group of inconspicuous tubular structures within the broad ligament, between the oviduct and the ovary, not far from the attached border of the latter organ (Fig. 46). The parovarium consists of a series of from twelve to eighteen short *tubules* which lie irregularly parallel, their ovarian ends slightly converging, and which are connected at their opposite extremities with the longitudinal *head-tube* of larger diameter extending for some distance within the broad ligament toward the uterus. The tubules are lined with low columnar epithelial cells, the representatives of the elements clothing the embryonic canals.

The parovarium represents the partially obliterated remains of portions of the Wolffian body of the fetus; the short canals correspond with the tubules of the body, while the head-tube is identical with the upper part of the Wolffian duct. When this latter canal persists throughout the greater part of its original extent, it constitutes *Gärtner's duct*, the homologue of the vas deferens; the entire parovarium corresponds morphologically with the tubules constituting the *globus major* of the epididymis.

Additional fetal remains in the form of rudimentary tubules are sometimes encountered within the broad ligament in the vicinity of the ovary, although situated rather nearer the uterus than the parovarium. These structures constitute the *paroöphoron*, and represent the atrophic transverse tubules of the lower part of the Wolffian body, being homologous with the *paradidymis* of

the male. The closed tubules of the paroöphoron are lined with low columnar epithelium and are often occluded by partially shed cells. The tubules of these atrophic organs possess a practical interest from their liability to become diseased and converted into cysts which may assume large diameters.

The *stalked hydatid* of Morgagni frequently forms a conspicuous appendage to the broad ligament near the fimbriated extremity of the oviduct (Fig. 55). This pedunculated vesicle, which varies greatly in size, represents the remains of the pronephros, being common to both sexes. Low columnar or cuboidal epithelium forms the lining of its dilated sac and stalk so far as pervious.



FIG. 55.—Stalked hydatid attached to fimbriated extremity of Fallopian tube (New York Hospital Cabinet).

The Vessels and Nerves of the Internal Generative Organs.

—The vascular and nervous supplies of the uterus and its appendages and of the ovaries are so intimately related that they may conveniently be considered together. These organs receive their blood from three sources—the uterine, the ovarian, and the funicular arteries (Pl. 7).

The *uterine artery* is given off from the internal iliac close to the pelvic wall, along which it runs as far as the broad ligament, within whose folds it then passes, in front of the ureter, toward the cervix uteri. After giving off twigs which surround this part of the uterus the artery ascends along the body of the uterus, sending off branches which anastomose with those from the opposite side to encircle the organ. The upper terminations of the uterine freely communicate with the branches of the ovarian and the funicular arteries.

The *ovarian artery*, the homologue of the spermatic, is a branch from the abdominal aorta, and gains entrance through the infundibulo-pelvic band into the broad ligament, within which it divides into its two principal branches—the *tubal* and the *ovarian*. The tubal branch extends along the border of the oviduct, sending numerous twigs for the nutrition of the tube and the tissue of the broad ligament. The *ovarian proper* is of larger size, and passes close to the free border of the ovary, which it particularly supplies, finally anastomosing with the uterine and funicular arteries near the upper angle of the uterus.

The *funicular artery* is given off from the vesical, after which it joins the round ligament at the internal abdominal ring and divides into ascending and descending branches, the latter passing into the labium along with the ligament, there to anastomose with the external pudic; the former ascends backward within the ligament as far as the angle of the uterus, where it joins the ovarian and the uterine arteries.

The *veins* of the uterus and of the ovaries are large and numerous and tend to form plexiform networks. Those of the *uterus*, always large, but of enormous size during pregnancy, form a plexus within the broad ligament, which plexus subsequently gives place to a trunk which accompanies the artery and terminates in the internal iliac vein. The *ovarian veins* are particularly well developed in the vicinity of the hilum; within the broad

ligament they form an intricate meshwork, the *pampiniform plexus*, which surrounds the artery and on the right side terminates in the inferior cava, on the left in the renal vein. The subperitoneal tissue contains great numbers of venous channels, the presence of which is a matter of practical import.

The *lymphatics* (Pl. 9, Figs. 2, 3) connected with the internal organs of generation begin as interstitial lymph-clefts and radicles which these viscera, in com-

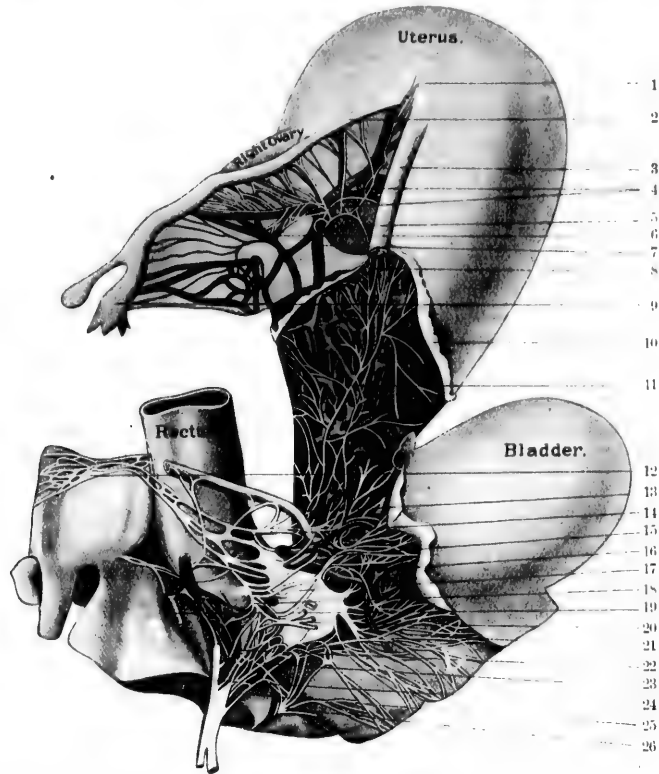


FIG. 56.—Nerves of the pelvic organs of the female (Frankenhäusen): 1, nerves to fundus of uterus; 2, right Fallopian tube; 3, right round ligament; 4, nerves to Fallopian tube; 5, communication between ovarian and uterine nerves; 6, ovarian plexus of veins; 7, ovarian vein; 8, nerve passing to join ovarian plexus; 9, fimbriated extremity of Fallopian tube; 10, reflected peritoneum; 11, uterine nerves; 12, superior hypogastric plexus; 13, branches from hypogastric plexus to uterus; 14, inferior hypogastric plexus; 15, vesical nerves; 16, communicating branches to vesical plexus; 17, cervical ganglion; 18, branches of hypogastric plexus to cervical ganglion; 19, first sacral nerve; 20, branches passing to bladder; 21, branches passing between bladder and rectum; 22, communicating branches from second sacral to cervical ganglion; 23, branch from third sacral nerve to cervical ganglion; 24, second sacral nerve; 25, branches from third sacral nerve to vagina and bladder; 26, branches passing from fourth sacral to cervical ganglion.

mon with others, possess in large numbers. The vessels thus originating are arranged as three principal groups: 1. The set composed of those coming from the body of the uterus, the ovary, and the oviduct, which end in the prevertebral lymph-glands in front of the aorta and the inferior cava; 2. Those from the

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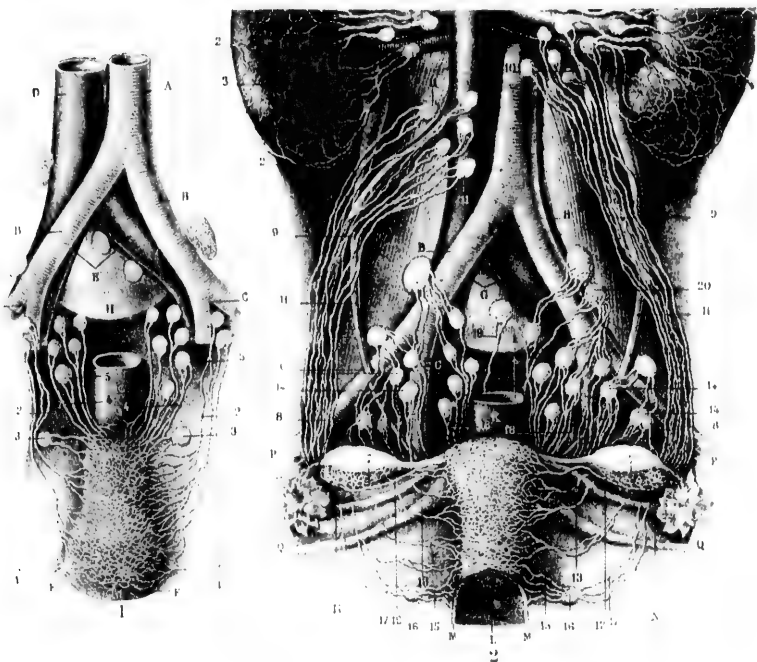
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EXPLANATION OF PLATE 9.

FIG. 1.—Lymphatics of the uterus, which has been turned forward (Sappey): A, aorta; B, common iliacs; C, bifurcation into internal and external iliacs; D, vena cava inferior; E, common iliac veins; F, uterus tipped forward; G, rectum; H, ligament uniting sacrum with fifth lumbar vertebra; I, lymphatic vessels passing under ovaries to follow the course of ovarian vessels; 2, lymphatics from body of uterus, which end in lymph-glands accompanying the iliac vessels; 3, lymph-glands receiving the lymph-vessels of mucous membrane of cavity of body; 4, 4, lymphatics from lower portion of surface of uterus, going to the glands behind internal iliac vessels, which glands (5) vary in number and volume.

FIG. 2.—Lymphatics of the pelvic viscera and the abdomen (Sappey): B, common iliacs; C, external and internal iliacs; D, vena cava inferior; E, common iliac veins; H, ureters; I, rectum; K, uterus; L, cervix; M, M, section of vagina; N, N, Fallopian tubes; O, O, ovaries; Q, Q, round ligament; 2, superficial renal lymphatics; 3, converging trunks of same, emptying into lymph-glands (4); 7, 7, lymphatic plexus of the ovaries; 8, 9, trunks receiving ovarian plexus following course of utero-ovarian veins; 10, 11, glands receiving the lymphatics from ovaries; 12, lymphatics from fundus, joining ovarian plexus, with same terminations; 14, glands receiving (13) trunks from surfaces and borders of body of uterus; 15, lymphatics originating in lower part of cervix, mucous membrane of uterine cavity and vaginal fornices; 16, lymph-glands occurring along the course of these vessels; 17, efferent vessels of these glands taking their course to the glands beneath external iliac vessels; 18, lymphatics which proceed from the posterior surface of the cervix, terminating in the glands accompanying the internal iliac; 19, exceptional lymph-trunk from cervix passing to gland in front of fifth lumbar vertebra; 20, another exceptional lymph-gland and vessel situated along the course of the common iliac.

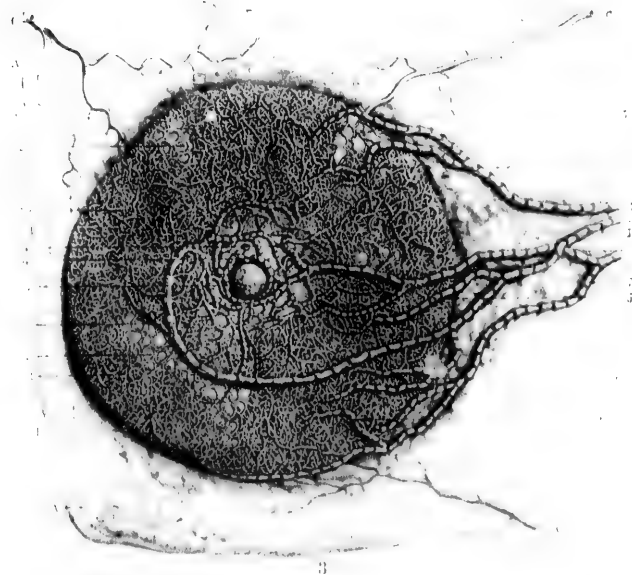
FIG. 3.—Lymphatics of the breast (Sappey): A, celluloso-adipose cushion supporting mammary gland; B, contour of mammary gland; C, superficial blood-vessels; 1, network of superficial lymphatics; 2, network of lymphatics originating in and draining the lobules of the gland; 3, large lymphatic trunks originating in the peripheral network; 4, plexus of lymphatics having their origin in the deeper parts of the gland; 5, large vessels originating in the inner part of this plexus; 6, 7, 8, large lymphatic trunks.



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1. Lymphatics of the uterus, which has been turned forward (Sappey). 2. Lymphatics of the pelvic viscera and abdomen (Sappey). 3. Lymphatics of the breast (Sappey).



cervix and adjacent part of the vagina, which extend along the base of the broad ligament and terminate within the internal iliac glands of the pelvis near the iliac artery at its point of division; 3. Those which accompany the round ligament and empty into the inguinal glands. These latter, as in the male, include two groups, those lying along the course of Poupart's ligament, which constitute the *oblique* set and receive the lymphatics from the genitalia, and those arranged about the saphenous opening as the *vertical* set, into which empty the superficial lymphatics of the lower limb. The great abundance of the lymphatics of the uterus, the cervix, and the vagina is a matter of much practical importance, since these channels furnish the paths by which septic matters may invade and affect parts widely removed from the focus of infection.

The *nerves* (Fig. 56) of the uterus, the ovary, and the oviduct are derived partly from the sacral nerves, particularly the third and the fourth, and partly from the sympathetic system as represented by the hypogastric and ovarian plexuses. The nerves include, therefore, both medullated and pale fibres, the latter being especially destined for the blood-vessels and the masses of involuntary muscular tissue.

The Mammæ.—The mammary glands, being really but highly specialized and greatly developed sebaceous follicles, belong to the integument, and, strictly regarded, have no place among the sexual organs. The closely associated functional relation of these organs in furnishing the nutriment for the newly-born animal, however, as well as convenience, has made it customary to describe them in connection with the organs of generation. The present purpose will require the consideration of the glands as developed in the female alone, the rudimentary organs of the male being disregarded.

The mammary glands of the human female (Fig. 57), as seen in well-developed women prior to pregnancy, protected by the integument and the fasciæ and the associated masses of adipose tissue, collectively form a pair of hemispherical prominences, the breasts, surmounted by the conical *mammillæ* or nipples.

The breasts as a whole are not quite circular in outline, since their attached bases present slight extensions inward over the sternum as well as outward, above and below, toward the axilla. Neither is the gland always limited by the deep fascia, since small aggregations of the glandular tissue may pierce the fascial septum and lie upon or become imbedded within the pectoral muscle—a matter of much practical moment in amputations of the mamma for malignant disease.

The size of the breasts depends so evidently upon the functional condition of the glandular tissue and the quantity and tonicity of the surrounding adipose tissue and other protecting structures that the dimensions of the organs must include a wide latitude of variation. The breasts may be said ordinarily to extend from the third to the seventh rib and from the sternal border to the anterior axillary margin, with a prominence depending much upon the amount of fat or upon the condition of the gland. The nipple is usually situated on a line corresponding with the level of the fourth rib, being directed somewhat outward and upward.

Varying with the general complexion, the nipple is of a roseate or a pinkish-brown tint, and is surrounded at its base by the *areola*, an area of modified integument about an inch in diameter, possessing the same color as the nipple. The changes in the appearance of this zone induced by pregnancy are more or less permanent, the deeply pigmented areola of the dark brunette never re-

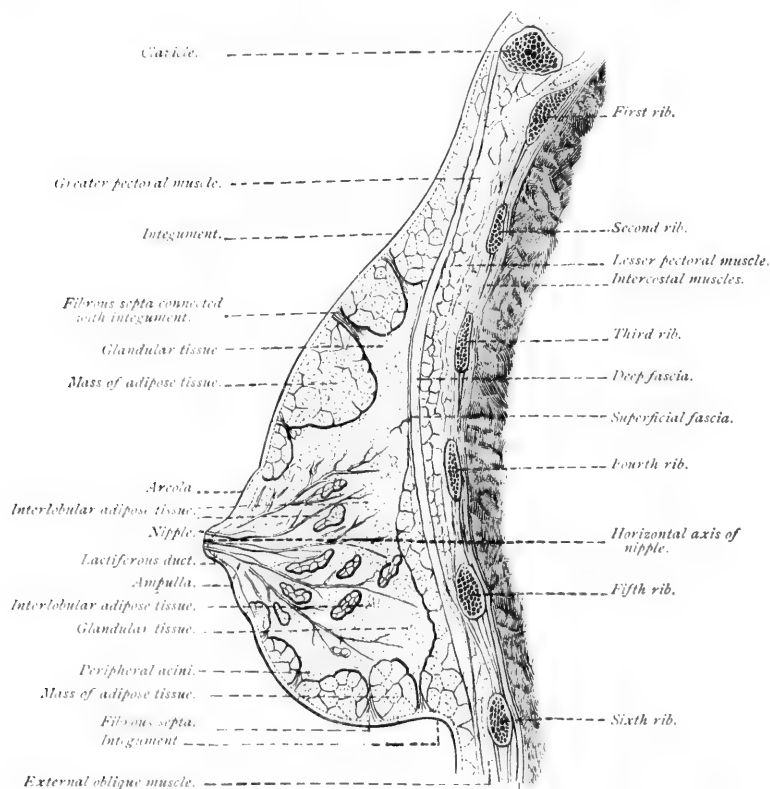


FIG. 57.—Longitudinal section of mammary gland *in situ*; frozen subject of twenty years (Testut).

gaining its former tint; in light blondes the darkening of the areola accompanying pregnancy is often very slight, and may subsequently almost entirely disappear.

The skin covering the areola is characterized by its variable pigmentation, by its delicacy, by the absence of subcutaneous adipose tissue, and by the presence of large sebaceous follicles, and, in addition to well-developed sweat-glands, small groups of glandular acini, the *accessory milk-glands*, of which from five to twelve are usually present. The sebaceous follicles during pregnancy become greatly increased in size and form prominent elevations, the *glands of Montgomery*. In addition to independent ducts open-

ing on the surface of the areola, the accessory glands sometimes are connected with the milk-tubes traversing the nipple.

Both the nipple and the areola contain numerous bundles of unstriated muscular tissue, arranged as circular and radiating fibres, which respond to mechanical stimulation. The contraction of the circularly disposed fibres causes the nipple to become more prominent or "erected;" the radial fibres, on the contrary, tend to depress or retract the nipple.

The *secreting tissue* of the mamma consists of an aggregation of pyramidal masses (from fifteen to twenty in number) of acini and ducts which correspond with the lobes composing the organ (Fig. 58). Each lobe represents a single highly developed and specialized sebaceous gland, whose excretory tube is the *lactiferous* or *galactophorous duct*, and whose secretory portion is the associated group of acini.

The individual component glands, the lobes, are invested by the surrounding connective tissue which constitutes the general supporting framework of

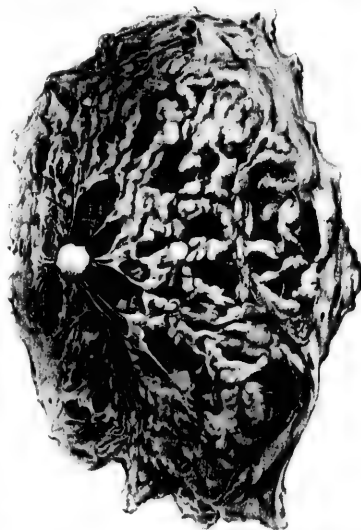


FIG. 58.—Arrangement of glandular tissue of breast, the fat having been removed to show the ducts and acini (Astley Cooper).

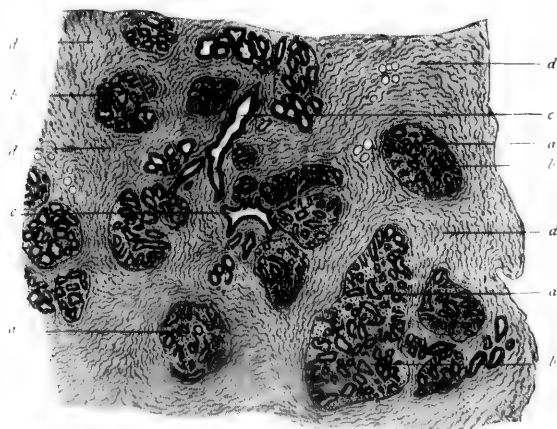


FIG. 59.—Section of mammary gland during lactation (sinety): a, a, lobules of secreting tissue, consisting of acini; b, b, lined with active epithelium; c, c, sections of excretory ducts; d, d, interlobular connective tissue.

the organ and the septa. The latter penetrate within the aggregations of acini and subdivide the lobes into lobules.

Before the occurrence of pregnancy and of the functional activity associated with lactation the secreting tissue forms but an insignificant portion of the entire volume of the mamma (Fig. 59), but during lactation the acini become enormously developed, the lobules of true glandular tissue being readily discovered as nodular masses within the more yielding areolar adipose envelope. Under the stimulus of the unusual demands made upon the organ

under such conditions, it is probable that new glandular tissue is formed as extensions of the existing acini.

The *acini* of the fully developed but non-functionating organ are lined by a single layer of short columnar or polyhedral epithelial cells, the protoplasm of which appears granular. The cells rest upon a delicate *membrana propria* which envelopes the acinus and which is continued on to the minute excretory ducts with which the acini are connected.

These passages, lined with a modification of the glandular epithelium, join with others to form larger tubes, which in turn take part in forming the interlobular canals. These canals are superseded by the wider excretory tubes draining the entire lobe, which, directly or after joining other tubes, become the converging lactiferous or galactophorous ducts.

The *lactiferous ducts* (Fig. 60) on reaching the areola undergo dilatation and form the *ampullæ* or *milk-sinuses*. These ampullæ lie beneath the areola, and during lactation attain each a diameter of from 4 to 6 millimeters, constituting important reservoirs for the milk secreted during the periods intervening between the evacuations of the gland. At the base of the nipple these ducts undergo a reduction in size and become closely collected, the larger tubes occupying the centre of the

group; surrounded by areolar and muscular tissues, they ascend to the summit of the mammilla as independent tubes, where they terminate by distinct orifices which open into minute depressions occupying the apex of the nipple.

The epithelium lining the ampullæ and the lactiferous ducts is of the low columnar or cuboidal variety; within a short distance of the termination of the ducts upon the nipple, the lining of the tubes changes its character to correspond with that of the adjoining epidermis, becoming stratified squamous.

The changes taking place within the lining cells of the acini on the establishment of lactation are very marked. In the earliest stage of activity, when



FIG. 60.—Dissection of breast, showing suspensory ligaments and milk-ducts (Astley Cooper).

the flow of milk first begins, many acini still retain their primitive condition of solidity: in such cases the elements occupying the central parts of the tubules undergo fatty degeneration, some becoming disintegrated, while others are cast off as masses which constitute the *colostrum-corpuscles* found in the milk during the first few days.

The uniformly granular protoplasm of the cells at rest becomes invaded by oil-drops when functional activity begins, and, as secretion progresses, it becomes broken up and displaced by the accumulation of oil-globules within the cell. The minute oil-drops exist at first as separate particles, which gradually increase in size until they become confluent and form a single large globule occupying the greater part of the entire cell. The nucleus in consequence is displaced toward the periphery, next the basement membrane, where it lies imbedded within the thin belt of protoplasm occupying the outer zone of the cell.

The acini within a single acinus generally contain very unequal amounts of oil; some of the elements are so loaded that the entire cell is occupied by the oil-drop, while, on the other hand, the neighboring cells may contain so little oil that the presence of the fatty particles is masked by the protoplasm. Between these extremes all gradations may be found.

Upon attaining a certain tension the contained oil-globules, escaping in the direction of least resistance, are discharged into the cavity of the acinus, where they, together with the granular debris of old epithelial cells, are collected within an albuminous fluid and constitute the *lactiferous secretion*, or milk. During secretion the acini possess a comparatively wide lumen, the epithelial layer forming but a thin lining to the irregular spherical or tubular spaces.

At the cessation of lactation the acini become once more reduced to narrow tubules, many being atrophic, surrounded by the thin preponderating areolar-adipose tissue. With each succeeding pregnancy a new period of cellular activity and new growth takes place in the preparation of the gland for its active rôle during lactation.

The close of the period of sexual activity is followed by gradual permanent atrophy of the secreting structures, so that secretions of the mammae of aged women show little more than the atrophic remains of the sometime conspicuous gland-acini imbedded within the connective tissue which, with a variable amount of fat, now constitutes almost the entire bulk of the organ.

The *blood-vessels* of the mamma are derived from two sources: principally from the internal mammary artery, through its perforating branches within the second, third, and fourth intercostal spaces, and from the axillary artery through the thoracic branches, the long thoracic or external mammary artery often sending off robust twigs for the supply of the gland.

The *veins* returning the blood from the deeper part of the organ follow the corresponding arteries; the superficial veins form a subcutaneous plexus which becomes conspicuous during lactation.

The *lymphatics* are very numerous, as demonstrated by the brilliant preparations made by Sappey (Pl. 9, Fig. 3), and they constitute a superficial and a deeper set. The former exist as an intricate subcutaneous network in which

the larger vessels are situated at the periphery, and join the lymph-paths converging toward the axilla. The deeper lymphatic vessels accompany the deeper veins and pass off in two groups: one set enters the axilla and terminates in the costal group of axillary lymph-glands; the other takes its course into the thorax and communicates with the chain of lymphatic nodules situated behind the sternum. The profuse supply of lymphatics and the intimate relations these bear to the lymph-glands situated deeply and at some distance greatly facilitate the conveyance of infectious materials to other parts, there to establish, as in the case of carcinoma mammae, new foci of disease.

The nerves supplying the mammary gland are derived from the cervical plexus through the superficial descending supraclavicular branches, and from the fourth, fifth, and sixth intercostals; numerous sympathetic filaments accompany the latter into the substance of the gland.

Variations in the number and position of the mammae have frequently been observed. While reduction in number or absence of these organs is extremely rare, increase in their number, as well as abnormal location, is by no means of great infrequency. The nipple alone may be involved, being either multiple or suppressed, or entire additional glands may be present.

Supernumerary mammae have been observed in many locations, among which the arm, the axilla, various parts of the anterior body-wall, the back, the buttock, and the thigh are the most conspicuous. The interesting observations of O. Schultze on the presence of definite "milk-ridges" along the antero-lateral aspect of the trunk in embryos, extending from the root of the upper limb to the inguinal region, suggest the location in which supernumerary mammae are most frequently encountered, such superfluous organs resulting from the persistence and development of areas which ordinarily disappear. The presence of such markedly aberrant mammae as those found on the back, the arm, or the buttock is less easily explained, since they arise probably in consequence of the unusual development of structures representing the ordinary sebaceous glands of the integument of the part.

III. PHYSIOLOGY OF THE FEMALE GENERATIVE ORGANS.

1. **Ovulation.**—The differentiation of certain of the cells derived from the ingrowth of the germinal epithelium covering the young ovary into the sexual elements proper, the ova, takes place very early, so that at birth the formation of the ova is already nearly completed, the production of new cells after birth being very limited, and probably entirely ceasing after the second year (Bischoff, Waldeyer). The ovaries of the child of two years, therefore, contain the full quota of ova, although the vast majority of these cells always remain immature and undeveloped. The entire number of these primitive sexual elements stored up within the ovaries of the young child has been estimated at about seventy thousand. While it is probable that a variable number of the immature ova undergo partial development before puberty, yet the advent of sexual maturity at that period marks the establishment of the full

and regular development of the Graafian follicles and their contained ova, accompanied by the usual attendant phenomena of menstruation.

Throughout the entire childbearing period, or from about the fifteenth to about the forty-fifth year, the development of the Graafian follicles, terminating in the rupture of the follicles and the discharge of the ova, is continually occurring. The liberation of the ova usually takes place at definite times, which in general coincide with the menstrual epochs, one or more ova being set free at each period. This agreement, however, is by no means necessary or invariable, since *ovulation*, as the ripening and discharge of the sexual elements is termed, undoubtedly proceeds independently of menstruation.

The ripe *human ovum* is a typical spherical cell, about 0.2 millimeter in diameter, consisting of granular protoplasm or the *vitellus*, in which lies a nucleus or *germinal vesicle*, about 0.045 millimeter in diameter, containing a well-marked nucleolus, the *germinal spot*. The proper cell-wall is the *vitelline membrane*, a structure of great delicacy, and often overlooked, outside of which the ovum is invested by the conspicuous *zona pellucida* (about 0.01 millimeter thick), which must be regarded as a secondary envelope contributed by the cells of the surrounding *discus proligerus*.

The fully-developed Graafian follicle is ovoid, and consists of an external investment of vascular connective tissue, the *tunica fibrosa*, which is lined by a thick layer of granular polyhedral epithelial cells, the *membrana granulosa*. At one point these cells are continued as a mass which immediately invests the ovum and which is known as the *discus proligerus*. The interior of the well-

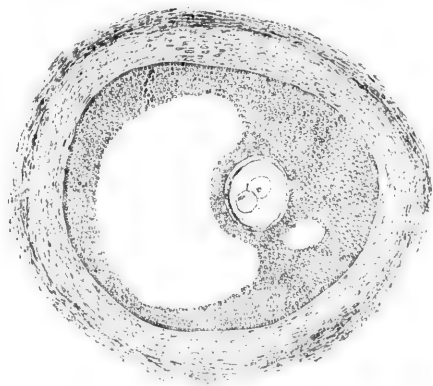


FIG. 61.—Section of well-developed Graafian follicle from human embryo (Von Herff): the enclosed ovum contains two nuclei.

developed follicle (Fig. 61) contains a fluid, the *liquor folliculi*, separating the ovum and its surrounding *discus* from the opposite wall of the sac. The most prominent part of the ripe follicle is less vascular than those parts subjected to less pressure, one spot, the *hilum folliculi*, being free from blood-vessels, and corresponding with the point at which the distended matured sac, from 2 to 4 millimeters in diameter, finally ruptures.

2. **Menstruation.**—At regular intervals throughout the childbearing period the lining of the uterus undergoes changes primarily designed to prepare a favorable resting-place for the product of conception. In the case of the non-occurrence of pregnancy these changes terminate in the disintegration of the uterine mucous membrane and in the discharge of blood, mucus, and tissue-débris that constitutes the phenomena of menstruation. Should pregnancy occur, menstruation is, as a rule, suspended during the entire time that the embryo is within the uterus, reappearing usually from six to eight weeks after the birth of the child. Exceptions to the customary prompt cessation of menstruation are by no means infrequent, the catamenial phenomena often recurring with regularity during the early months of gestation. The anatomical explanation of this variation is found in the fact that the uterine cavity is not obliterated by the apposition of the decidua reflexa against the mucous membrane of the uterus or the decidua vera until the end of the fifth month. The very rare occurrence of the menses throughout gestation is probably associated with an abnormal and imperfect fusion of the deciduæ. The reputed instances of women menstruating only during pregnancy must be viewed with suspicion, since the discharge in such cases probably always results from pathological conditions of the cervical canal.

The complete menstrual cycle, which typically occupies twenty-eight days, may be divided into four stages (Marshall), following one another in regular sequence and lasting a definite proportion of the entire period:

(1) The first or *constructive stage* is one of preparation for the reception of an ovum, and is characterized by the formation of a menstrual decidua in the preparation of which swelling of the mucous membrane, enlargement of the uterine glands, and increase of the connective tissue all take place. This stage probably lasts about one week, and is followed, when pregnancy has not occurred, by degenerative changes.

(2) The second or *destructive stage* is marked by the destructive processes which give rise to the usual phenomena of the menstrual period, including the discharge of mucus, blood, and disintegrated uterine mucous membrane. Five days constitute the average duration of the menstrual flow, although its continuance may be extended or curtailed, owing to individual peculiarities.

(3) The third or *reparative stage* is one of repair, during which the deeper and unaffected parts of the uterine mucous membrane institute constructive processes which within the short period of from three to four days result in the formation of a new mucosa.

(4) The fourth or *quiescent stage* includes the remaining twelve or fourteen days of the menstrual cycle, and represents the quiescent period preceding the initiative changes marking the beginning of the next period.

The relations between ovulation and menstruation are of great interest, for, although the discharge of the ripened ovum and of the degenerated uterine decidua takes place usually simultaneously, it is well established that it is neither invariably nor necessarily so, since authenticated observations have shown that menstruation may be unattended by the liberation of an ovum. While these

two processes, as a rule, may be regarded as associated, the determination of the exact relation between the discharged ovum and the uterine changes coincidently taking place is not yet positively established. It may be assumed that the first or constructive stage in the cycle of uterine changes is particularly favorable for the reception of the ovum: this being the case, it is evident that the preparation of the uterine mucous membrane cannot be directed toward the reception of the ovum, whose discharge takes place with the coincident menstrual phenomena, since it is probable that at least a week is occupied in the transit of the egg from the ovary to the uterus. Marshall's conclusions, that "the decidua of a particular menstrual period is related, not to the ovum discharged at that period, but to the ovum discharged at the preceding period," are fully warranted by the more exact data furnished by careful observation. The well-known coincidence of ovulation and menstruation finds its partial explanation, at least, in the marked congestion of the ovaries and the consequent stimulation and vascular engorgement which the uterus experiences by reason of the close arterial anastomoses between the vessels of these organs, the resulting turgescence probably being an important factor in establishing the menstrual flow.

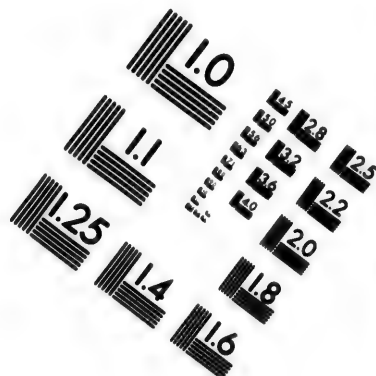
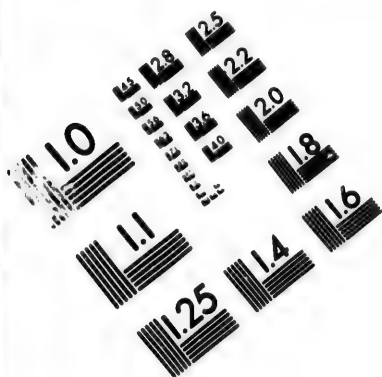
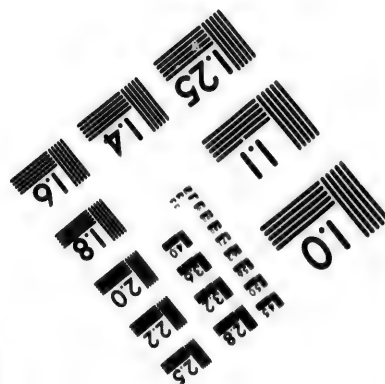
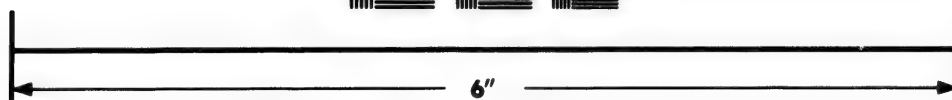
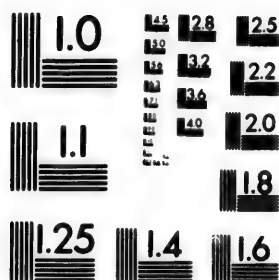


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II. PREGNANCY.

I. PHYSIOLOGY OF PREGNANCY.

I. DEVELOPMENT OF THE EMBRYO AND THE FETUS.

1. **Maturation and Fertilization.**—Coincident with the growth of the Graafian follicle, which culminates in the rupture of the sac and the discharge of the liquor folliculi and the egg surrounded by the discus proligerus, the ovum passes through a series of changes collectively termed *maturation*, by which the female sexual cell is prepared for the reception of the male element, without the completion of which preparation fertilization of the ovum is impossible.

The maturation of the ovum consists essentially in the very *unequal* and *repeated* division of the egg, by which two minute portions of its substance,



FIG. 62.—Portions of ova of *Asterias glacialis*, showing changes affecting the germinal vesicle at the beginning of maturation (Hertwig): a, germinal vesicle; b, germinal spot, composed of nuclei and paranuclei (c); d, nuclear spindle in process of formation.

the *polar bodies*, are extruded; the remainder of the cell after the completion of this cycle returns to a quiescent condition to await the advent of the male sexual element. Maturation takes place entirely independently of the influ-

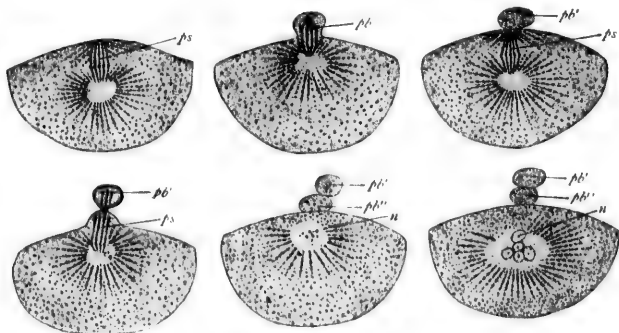


FIG. 63.—Formation of polar bodies in ova of *Asterias glacialis* (Hertwig): ps, polar spindle; pb', first polar body; pb'', second polar body; n, nucleus returning to condition of rest.

ence of the male or of the probability of fertilization, every healthy ovum undergoing these changes before it becomes sexually ripe.

The process, in brief, consists of the following phases: (a) The migration of the germinal vesicle or nucleus toward the periphery of the cell (Fig. 62); (b) the rupture and the disappearance of the nucleus, and the formation of the

nuclear spindle and other elements of the complicated cycle of indirect cell-division; (c) the extrusion of a minute portion of the ovum as the *first polar body* (Fig. 63); (d) short quiescence followed by a repetition of division, resulting in giving off the *second polar body*; (e) the establishment of equilibrium, the appearance of a new and smaller nucleus, the *female pronucleus*



FIG. 64.—A, mature ovum of echinus; n, female pronucleus; B, immature ovarian ovum of echinus (Hertwig).

(Fig. 64), and the return to a condition of rest. Maturation usually takes place just before the rupture of the follicle and the escape of the ovum.

On the completion of the phenomena of maturation, the ovum is prepared for the reception of the male element, the meeting of the sexual cells in mammals usually taking place within the upper portion of the oviduct.

The number of the more vigorous seminal elements deposited within the vagina that work their way through the uterine cavity and into the oviducts must be but an insignificant part of the entire number lodged about the external os. Of those, moreover, fortunate enough to overcome the obstacles pre-



FIG. 65.—Portions of the ova of *Asterias glacialis*, showing the approach and fusion of the spermatozoön with the ovum (Hertwig): a, fertilizing male element; b, elevation of protoplasm of egg; b', b'', stages of fusion of the head of the spermatozoön with the ovum.

sented to their progress within the uterus and tubes, but a single spermatozoön actually takes part in the fertilization of the ovum.

After reaching the surface of the egg and penetrating the zona pellucida the successful spermatozoön is met by a slight projection of the protoplasm of the ovum, with which the head of the male element soon becomes blended (Fig. 65). The tail is lost, and the head later sinks within the substance of the egg. Subsequently the position of the impregnating element is indicated

by the appearance of a small round or ovoid body, the *male pronucleus* (Fig. 66, A, B), whose vicinity is rendered conspicuous by the radial striation marking the surrounding protoplasm. The male and female pronuclei now approach, and sooner or later meet and become blended, their union producing the *segmentation-nucleus* (Fig. 66, C) from which are formed the new generations of elements, to the constitution of which both parent-cells have contributed.

It is of interest to note that, since the parts of the sexual cells most concerned in the production of the segmentation-nucleus are rich in chromatin, a fusion of the nuclein seems to be the essential feature of the process of fertilization. The blending of both parent-cells within the segmentation-nucleus furnishes the explanation as to the fundamental manner of transmission to the off-spring of the individual peculiarities of both father and mother, since the new being depends for its origin upon a nucleus to which both parents have contributed and by which the characteristics of both are perpetuated.

Should the matured female element fail to meet the spermatozoön, the ovum after a few days loses its vitality and perishes. The period during which the human egg retains the possibility of fertilization has been variously estimated, about eight days being the probable limit of the retention of this power, since the death of the unfecundated ovum usually occurs before the egg reaches the uterus.

2. Segmentation.—The meeting and fusion of the male and female pronuclei, already described, result in the formation of the new segmentation-nucleus (Fig. 66, C), whose appearance institutes the process of cell-division by

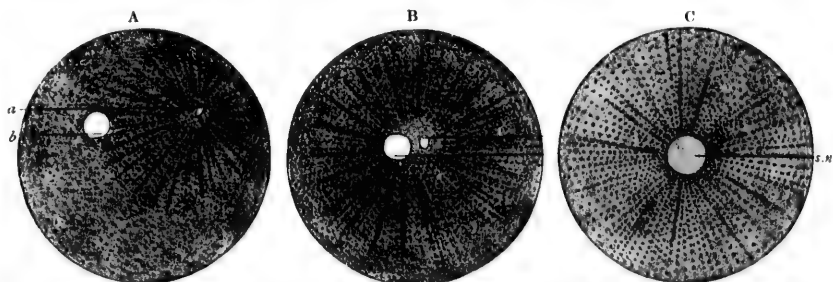
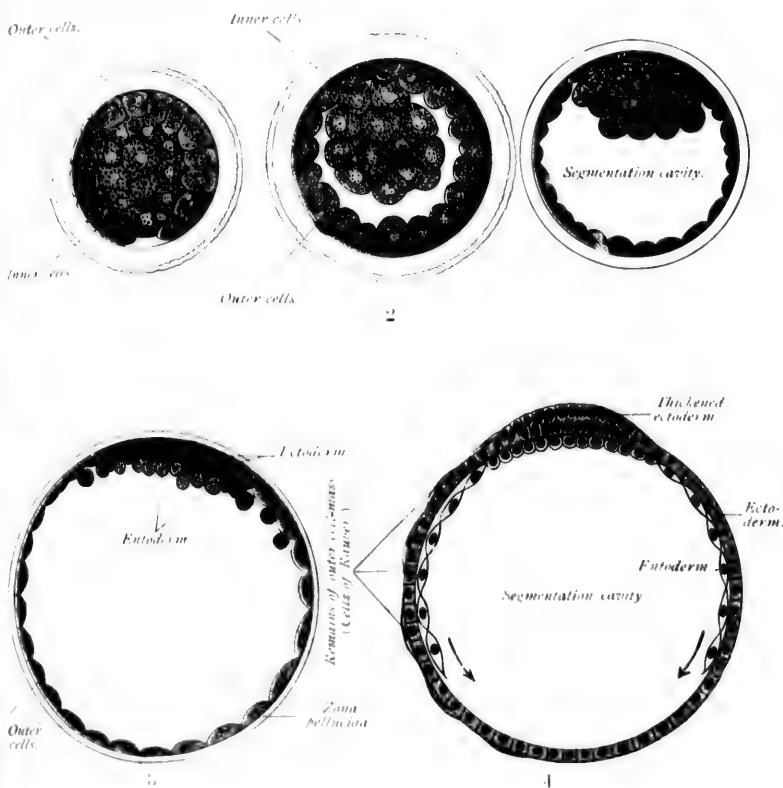
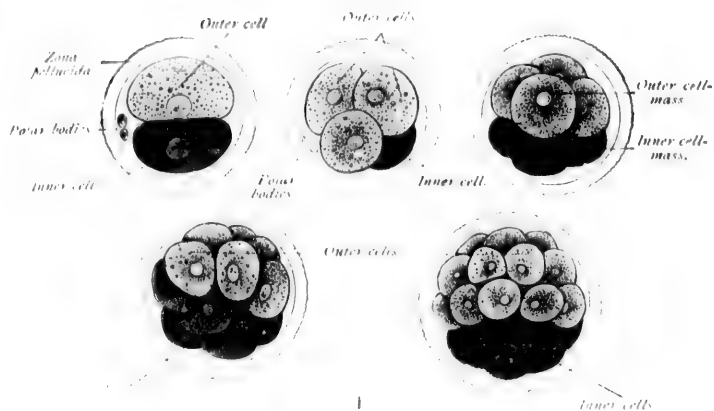


FIG. 66.—A, fertilized ova of echinus (Hertwig): the male (a) and the female pronucleus (b) are approaching; in B they have almost fused; C, ovum of echinus after completion of fertilization (Hertwig): s.n., segmentation-nucleus.

which the original egg-cell gives rise to an extended series of generations, leading to the production of the blastoderm.

Since the youngest human embryo carefully examined and recorded—that of Reichert—was already probably twelve days old, the early phenomena of impregnation and segmentation have never been observed in man. Direct observations upon higher mammals, as the dog and the rabbit, have supplied our knowledge of the details of these early stages of development, which, in the main, probably closely correspond with the changes taking place within the human ovum. Nagel's examination of a ripe human ovum and the dis-



SEGMENTATION.—1-3. Diagrams illustrating the segmentation of the mammalian ovum (Allen Thompson, after E. v. Beneden). 4. Diagram representing the relation of the primary layers of the blastoderm (Bonnet).

covery of the presence of two polar bodies, as in other mammals, still further justifies the assumption of this similarity.

The minute amount of food-yolk possessed by the mammalian egg is uniformly distributed throughout its protoplasm, and is not collected as a distinct body; such ova are therefore known as *alecithal*. As influenced by the amount and arrangement of the yolk, these ova experience entire cleavage during their division, and are said to undergo total segmentation, being therefore *holoblastic*. Since the resulting cells may be regarded as practically equal in size, their type of segmentation may further be designated as *equal*. The human ovum, therefore, is technically described as an *alecithal, holoblastic egg* undergoing equal segmentation.

Almost directly after the appearance of the nucleus of segmentation, the phenomena of cell-division appear within the parent-cell, the cycle resulting in the formation of the first pair of daughter-cells (Pl. 10, Figs. 1-3). These cells in turn become the seat of similar activity by which four cells are produced, the process of cell-division continuing until the original element is represented by many generations of direct offspring. While, for convenience, the segmentation of the mammalian egg may be regarded as equal, yet, when closely examined after the third or fourth cleavage, a slight difference may be noted in the size of the resulting elements, or *blastomeres*. This discrepancy, insignificant in its individual variation, becomes gradually manifested by the separation of the blastomeres into an *inner* and an *outer cell-group*, the cells of the outer group undergoing more rapid increase than those of the inner group, which latter cells, in consequence of this inequality in growth, gradually are invested by an enveloping layer composed of the outer cells (Pl. 10). This process of covering-in progresses until the outer cells constitute a complete envelope, the entire segmented ovum now corresponding with the mulberry mass, or *morula*, of the older anatomists.

Examined in section, the ovum at this stage consists of the single layer of outer cells, to the inner surface of which at one point adheres the less-expanded group composed of the inner cells, the space between the two, the *segmentation-cavity*, being occupied by a clear albuminous fluid. This stage of the hollow sphere of the mammalian ovum is known as the *blastula* or *blastodermic vesicle* (Pl. 10, Fig. 4).

The further changes within the blastula are marked by the rapid and enormous increase in the size of the ovum, in consequence of which increase the outer cell-layer undergoes great extension, with corresponding attenuation of its elements, which are changed into thin, scale-like plates.

Coincidentally with these changes affecting the layer of outer elements, the group of inner cells has undergone an important although inconspicuous modification, in consequence of which a differentiation of these cells into a rapidly proliferating peripheral layer, next the thinned-out stratum of investing outer cells, and a more slowly dividing central mass has taken place (Pl. 10, Figs. 1-3). This peripheral layer is the primitive *ectoderm proper*; the inner mass is the primitive *entoderm*.

With the growth of the ectodermic layer the primary outer cells become more attenuated, and after a time blend with the developing ectodermic tissue,

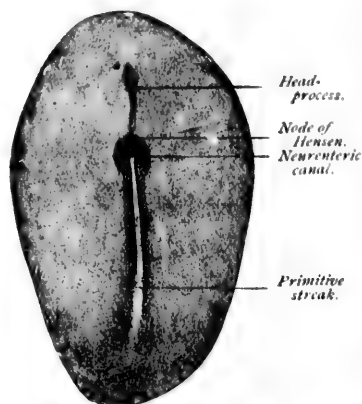


FIG. 67.—Embryonic area of rabbit embryo (E. v. Beneden): primitive streak beginning in cell-proliferation, known as the "node of Hensen."

the two together constituting the early true ectoderm. When this structure is examined its surface is found covered with flat elements, fusiform in profile, known as *Rauber's cells* (Pl. 10, Fig. 4), which later disappear and seemingly take little or no rôle in the formation of the permanent ectodermic structures. The cells of Rauber are probably the remains of the attenuated layer of the primary outer cells. The ectoderm expands on all sides until the entoderm as well as the entire yolk-cavity of the ovum is completely enclosed.

If a mammalian ovum at about this stage be examined from the surface, the blastodermic vesicle on one side presents an oval or pyriform field of greater density: this is the *embryonal area*, and corresponds to that portion of the blastula especially concerned in the development of the embryo. Very early a linear opacity known as the *primitive streak* (Fig. 67) makes its appearance at the smaller or posterior pole of the embryonal area, and seemingly grows forward toward the centre of this field.

On section the primitive streak is seen to depend upon a line of proliferating tissue which marks the position of fusion and intimate union of all the embryonal blastodermic layers (Figs. 68, 69). Very soon the primitive streak becomes occupied by a median longitudinal furrow, the *primitive groove*. The significance of this pre-embryonic structure is still a subject of much discussion. Without entering into the details of the somewhat theoretical and complicated considerations of the subject, it may be mentioned that there are ample grounds for accepting the views of His, Minot, and others that the primitive streak of the higher types represents morphologically the fusion of the lips of the *blastopore*—the opening formed among the lower types by the invagination of the blastodermic vesicle at one point in the production of the *gastrula stage*.

In contrast with the usual appearance of mammalian ova, the early human ovum is characterized by the precocious development of villous projections, so that as early as the twelfth day, as represented by Reichert's ovum (see Fig. 83), its exterior presents well-marked elevations. These villi, however, are not uniformly distributed over the ovum, but are limited to the marginal zone of the compressed spherical egg, the two flattened sides being smooth and devoid of villi. The embryonic area corresponds in position with one of the poles of the shorter axis of the ovum that connects the smooth sides, although at this stage little if any trace of the embryo is to be seen.

Coincidentally with the further growth and differentiation of the two-layered blastula, a third layer, the *mesoderm*, makes its appearance (Fig. 68). The origin of this lamina is still a subject of much discussion, but it may be accepted as demonstrated that the mammalian mesoderm arises from two sources—principally by a splitting off or delamination from the entoderm,

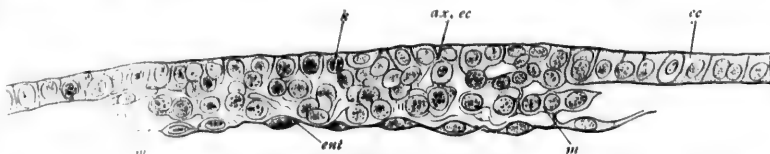


FIG. 68.—Section across the primitive streak of rabbit embryo (Kölliker): *ec*, ectoderm; *ax, ec*, axial ectoderm undergoing proliferation, as shown by karyokinetic figures (*k*); *ent*, entoderm; *m*, mesoderm.

supplemented by a proliferation involving the ectoderm along the anterior part of the primitive streak. This latter structure therefore marks the axis along which complete fusion of the three blastodermic layers takes place before the formation of the true embryo has started. The primitive streak is a transient structure, and gives rise to no part of the embryo; later it entirely disappears.

The growth of the mesoderm is rapid, and soon produces a layer particularly developed toward the caudal pole of the embryo, expanding in broad lateral fields on either side. Viewed as a whole, the mesodermic sheet appears pyriform, with its smaller end directed anteriorly or opposed to the corresponding part of the embryonal area. At first a continuous layer, the

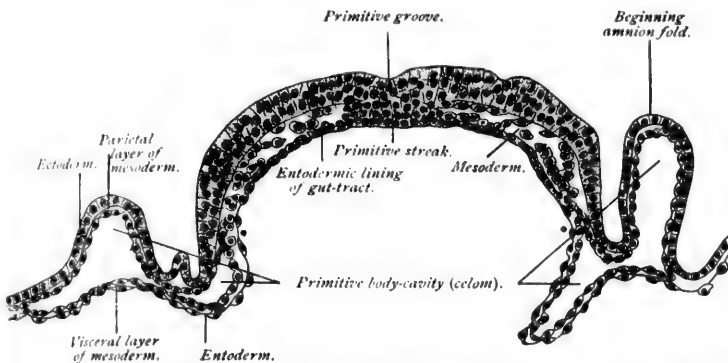


FIG. 69.—Transverse section of the embryonic area of a fourteen and a half day ovum of sheep (Bonnet).

mesoderm later becomes displaced along the immediate axis of the embryo, this division resulting in the formation of two closely approximated but separated halves: in each of these a *paraxial* and a *lateral tract* are further to be recognized. The latter undergoes cleavage by the formation of the intra-mesodermic *body-cavity* or the *celom* (Fig. 69); the resulting upper and lower lamellae constitute respectively the parietal and visceral layers of the mesoderm. The parietal or somatic layer joins the ectoderm to form the *somato-*

pleure; the visceral or splanchnic layer unites with the entoderm to form the *splanchnopleure* (Fig. 70). These structures later produce the body-walls and the walls of the primitive digestive tube.

About the end of the second week the human ovum enters upon the earliest initial stages of the formation of the embryo proper. In addition to

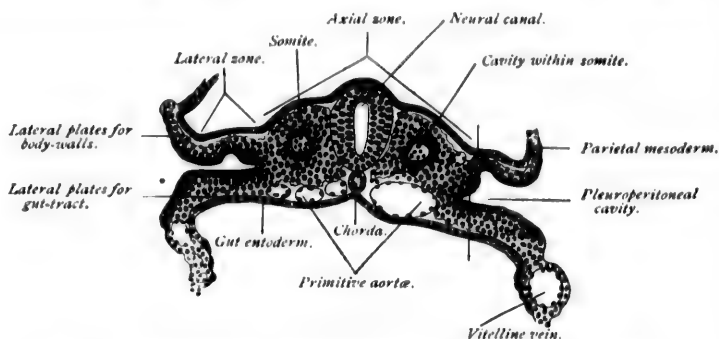


FIG. 70.—Transverse section of a seventeen and a half day sheep embryo (Bonnet).

the primitive streak, which, as above stated, is a transient structure having nothing directly to do with the embryo, the fundamental developmental processes include the formation of the *neural folds* and the *neural canal*, the *chorda dorsalis* or *notochord*, and the *somites* or *provertebrae*.

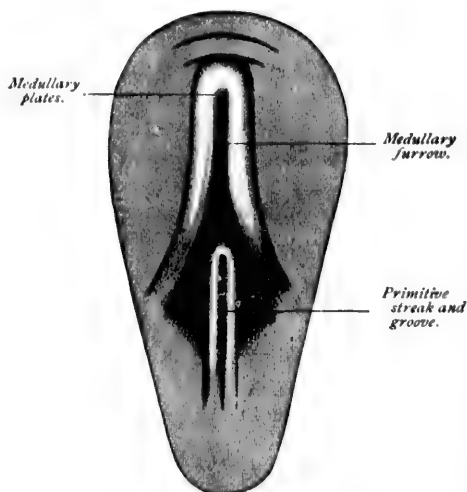


FIG. 71.—Surface view of area pellucida of an eighteen hour chick embryo (Balfour).

Neural Canal.—The development of this structure consists first in the appearance of the *neural* or *medullary folds*, which together constitute a Λ -shaped duplication embracing the anterior extremity of the primitive streak; by the thickening and the approximation of the summits of these folds the *neural* or *medullary groove* is produced (Fig. 71). This furrow is later converted into the neural canal, the early representative of the nervous system, by the further growth

and union of the folds along the dorsal line of contact, the closure being first effected near—not, however, at—the cephalic extremity of the embryo, but some little distance farther caudally, at a position which later corresponds with

the cervical region of the spinal cord. The extreme cephalic end of the neural canal undergoes expansion into three primitive brain-vesicles. The neural folds of the caudal portion for a long time remain widely separated.

Chorda Dorsalis.—The appearance of the *chorda dorsalis*, or the *notochord*, establishes the earliest representative of the *longitudinal axis* which constitutes the fundamental characteristic of all vertebrates. While the earliest development of this structure has not been observed in man, it is fair to assume a close correspondence with the process as studied in other mammals. In these the mesial portion of the entoderm gives rise to a cell-group (Fig. 72) which gradually becomes separated from the inner layer and displaced, so that the

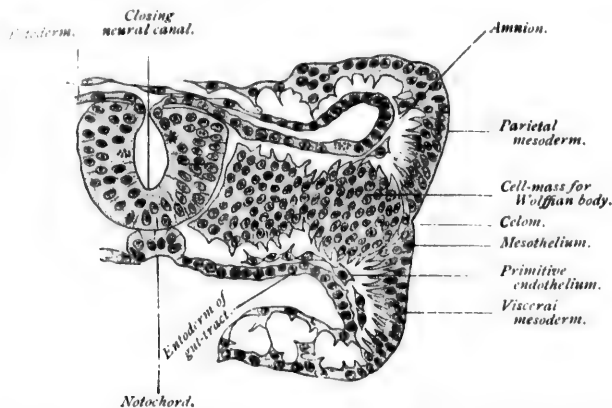


FIG. 72.—Transverse section of a fifteen and a half day sheep embryo possessing seven somites (Bonnet).

resulting cell-mass forms a slender cylinder which stretches from the anterior extremity of the embryo to its caudal pole. On section the notochord appears as an oval group of cells situated immediately beneath the neural groove or canal and above the entodermic layer (Fig. 74). The notochord, for a time representing the longitudinal axis of the embryo, is usually replaced by the permanent vertebral axis, at first cartilage and later bone. The remains of this embryonal structure in man are seen in the central areas of spongy material occupying the intervertebral disks.

Somites.—The formation of the *somites* or *provertebrae* marks the establishment of the segmentation which later is permanently effected by the development of the vertebrae and the associated parts of the trunk. The production of the somites is so closely related to that of the mesoderm that the primary arrangement of this important sheet must be recalled. After its origin from the double source of entoderm and ectoderm, the mesoderm rapidly expands laterally, the growth being particularly active toward the caudal pole of the embryo, in consequence of which the layer becomes pyriform in outline when seen from its upper surface. At first a continuous sheet, the further development of the neural groove from above downward and of the notochord from

below upward soon divides the mesodermic tract along the embryonic axis into two great wings (Fig. 73).

Each of these wings undergoes further differentiation into a paraxial band next the mid-line, and a lateral plate which blends away laterally into the

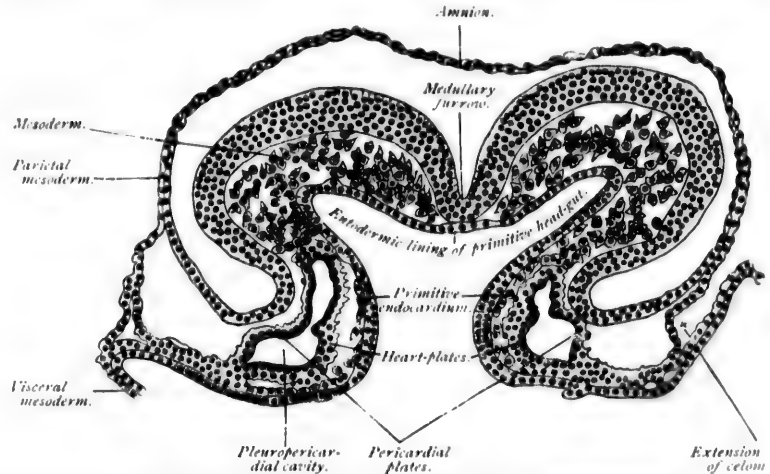


FIG. 73.—Transverse section of a sixteen and a half day sheep embryo (Bonnet).

widely extending mesodermic area (Fig. 74). The lateral mesodermic plate undergoes cleavage into an upper and a lower lamina which respectively adhere to the ectoderm and the entoderm. The upper and outer of the resulting two-layered lamellæ constitutes the *somatopleure*; the under and inner one,

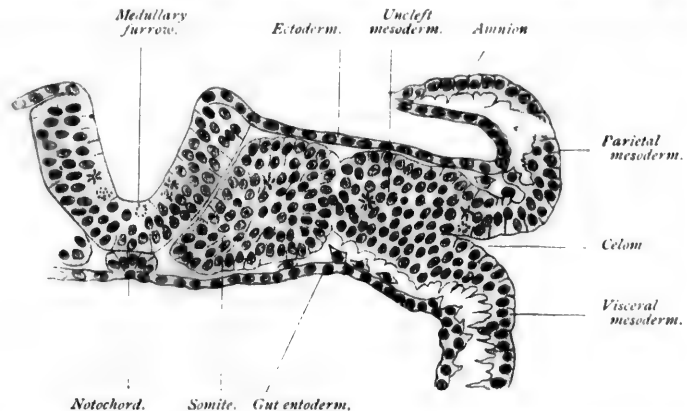
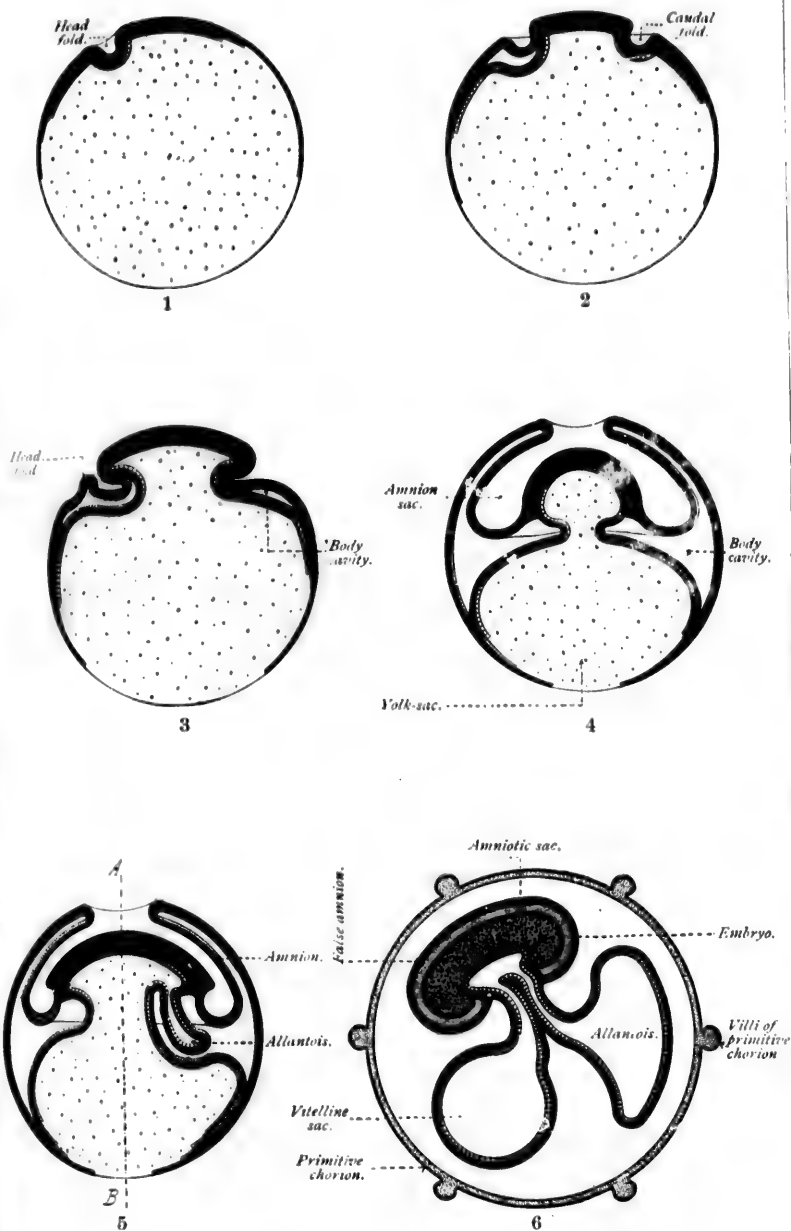
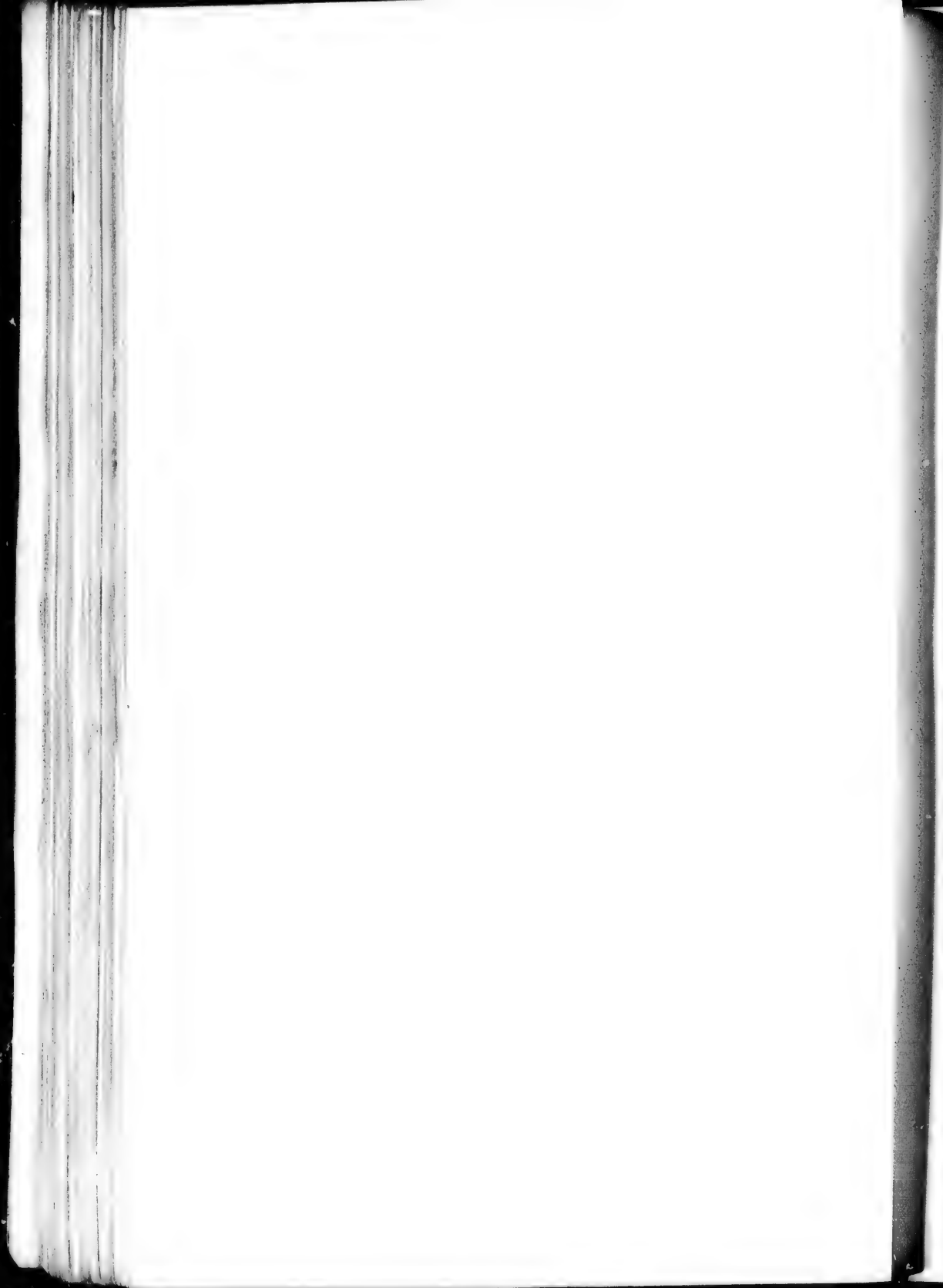


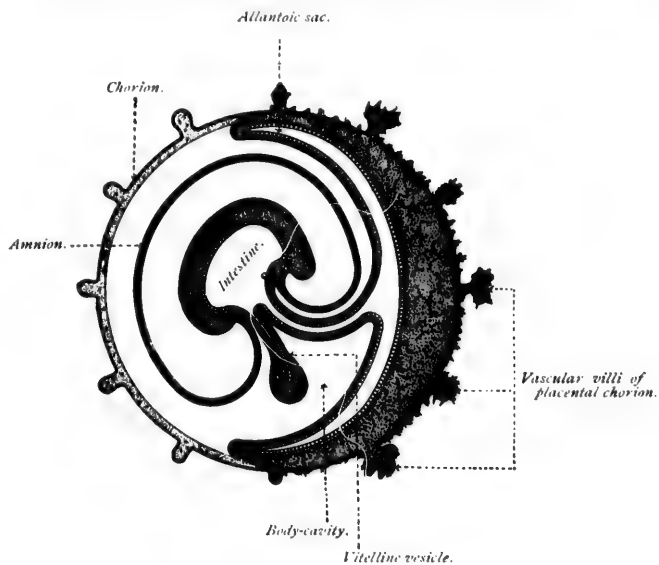
FIG. 74.—Transverse section of a sixteen and a half day sheep embryo possessing six somites (Bonnet).

the *splanchnopleure*. The space included between the two leaves of the cleft lateral mesoderm is the *primitive body-cavity* or *celom*, which afterward becomes the *pleuro-peritoneal cavity*.

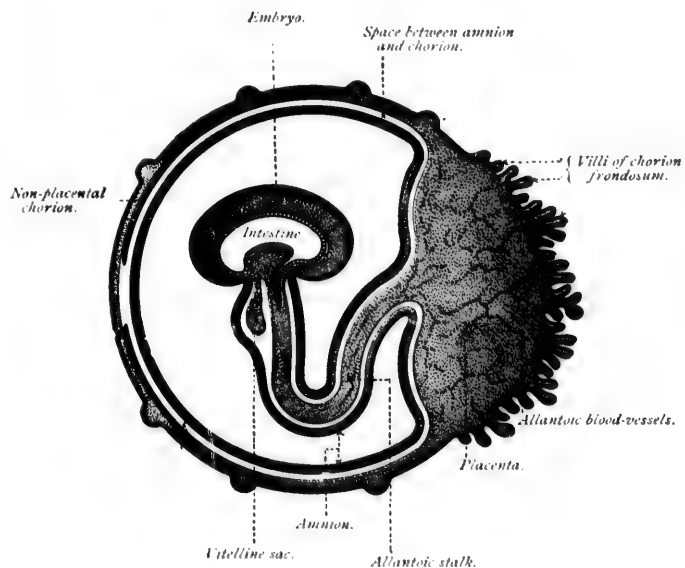


1-6. Diagrams illustrating the formation of the mammalian fetal membranes (modified from Roule).



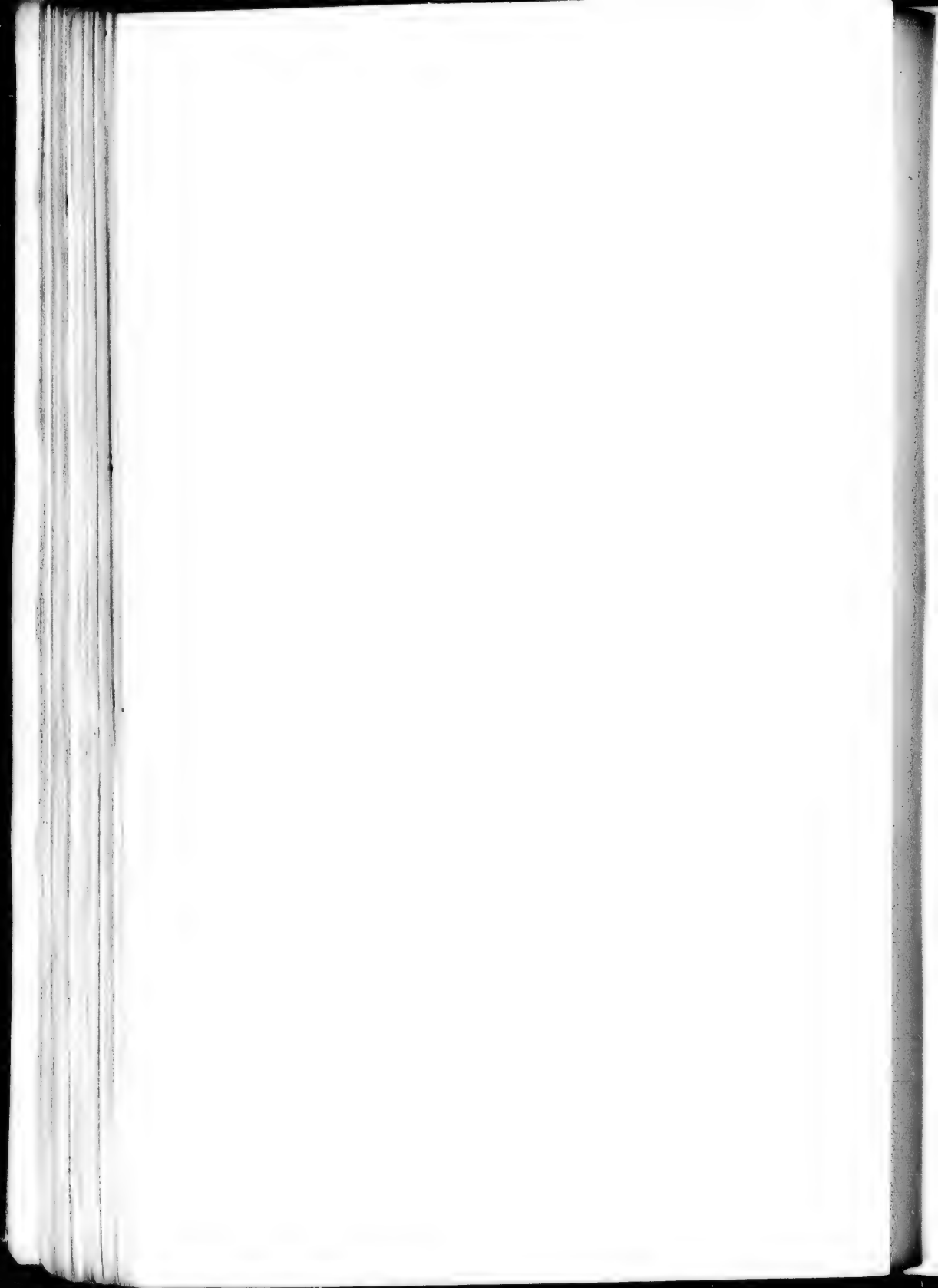


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1, 2. Diagrams illustrating the later stages of the formation of the mammalian fetal membranes (modified from Rouley).



The *paraxial* band of mesoderm does not undergo cleavage as do the neighboring lateral mesodermic areas, but instead it suffers a transverse division into a series of small quadrilateral areas, the *somites* or *provertebræ*. These areas first appear immediately behind the cephalic expansion of the neural canal and progress toward the caudal pole, at particular stages of the human embryo, as from the twenty-first to the thirty-fifth day, forming a series of conspicuous markings on each side of the dorsal mid-line as far as the extreme caudal extremity (Fig. 129).

The somites are transient and are not represented by adult structures, since the segmentation of the permanent vertebræ which later appears does not correspond with that of the somites, the areas producing the vertebræ falling in such manner that portions of the somites are embraced by a single vertebra. While not directly related to the formation of the vertebral column, the somites contribute to the production of the important muscular tissues, since the outer portions of their masses become converted into peculiar flattened bands, the *muscle-plates*, from which proceeds the development of the great tracts of voluntary muscle, at first of the trunk, later of the limb appendages.

3. **Fetal Membranes.**—Coincidentally with the progress of the fundamental processes just described, the formation of envelopes for the protection and establishment of means for the further nutrition of the embryo takes place: these envelopes are known as the *fetal membranes* (Pls. 11, 12), which, in connection with the structures derived from the thickened uterine lining, constitute the membranes thrown off at birth.

The *amnion* (Pl. 11, Figs. 4, 5), the earliest of the envelopes, appears soon after the formation of the neural folds and groove as duplicatures of the somatopleure which start in front, behind, and at the sides of the embryo. The anterior amniotic fold in man grows with unusual rapidity, and, aided by the lateral folds, soon covers in the embryo from before backward, the caudal extremity being the last to be enveloped. The line of union of the several duplicatures has received the name *amniotic suture*. Examined in section, the amnion is seen to comprise not only the ectodermic tissue, but also the extension of the parietal or somatopleuric layer of the mesoderm. On reference to the Figures of Plate 11 this relation will be seen illustrated, as well as the mode by which the folds meet over the dorsal surface of the embryo to form the amniotic sac, which, when entirely closed, contains the amniotic fluid separating the envelope from the developing animal. While union and fusion of the innermost layers of the ecto-mesodermic folds of the somatopleure produce the true amnion with its contained sac lined with ectoderm, the separation of the fused outer laminae of the duplicatures from the amniotic portion gives rise to a second externally-lying envelope, the *false amnion*, or *serous membrane*, in which the disposition of the component layers is reversed, since the ectoderm lies without, and the mesodermic tissue next the included space. The latter is directly continuous with the interval between the parietal and visceral laminae of the cleft mesoderm, and is the extra-embryonal portion of the primitive body-cavity, which thus extends widely beyond the limits of the embryo proper.

With the accumulation of the liquor amnii the amnion becomes separated from the embryo and is pushed against the surrounding envelopes.

The amniotic fluid, or liquor amnii, is a serous fluid produced probably by the amnion itself, having a specific gravity varying from 1.007 to 1.008; it contains from 1.07 to 1.06 per cent. of dry solids (Prochownik). The amount of the amniotic fluid is subject to great variation, the average quantity at full term being between 700 and 800 cubic centimeters, or less than one liter. Notwithstanding numerous investigations, there appears to exist no constant relation between the quantity of the amniotic fluid and the weight of the child or of the after-birth. In addition to the evident use of the fluid for the mechanical protection of the embryo, it is probable that it affords a source of water to the developing animal, since there is strong evidence to show that the fluid is continually swallowed during the greater part of intra-uterine existence. Toward the later months of gestation the pressure induced by the growing fetus and the large amount of the amniotic fluid pushes the amnion into close contact with the surrounding false amnion, the two becoming closely, although not inseparably, united by the end of gestation.

As the embryo gradually assumes a more definite general form, the roots of the true amniotic folds sink more and more ventrally until they meet, thus closing in the body-cavity and forming its anterior wall. In the early stages, when the yolk-sac or umbilical vesicle communicates with the widely open gut-tract by means of its broad stalk, approximation of the somatic plates is prevented. With the decrease of the umbilical vesicle and the corresponding diminution in its stalk the ventral plates grow together and rapidly close the pleuro-peritoneal cavity except at one point, the umbilical opening, through which pass those structures that connect the embryo with organs lying without its body, as the umbilical and allantoic blood-vessels and stalks with their accompanying lumina.

The Allantois.—The *allantois* appears as an outgrowth from the hind-gut (Pl. 11, Figs. 5, 6) after the primitive digestive tube has become well defined and partially closed. When typically developed the allantois grows out as a free sac into the space between the true and the false amnion, rapidly increasing in size. In man, however, the allantois at no time exists as a free vesicle, since it almost at once forms attachments with the structures extending from the caudal extremity of the human embryo as the *abdominal stalk* (Fig. 75), in which is included the lumen of the imprisoned allantoic sac.

The primary function of the allantois is to act as a receptacle for the excretory allantoic fluids thrown off by the Wolffian bodies, by which primitive organs the effete matters are removed as by the kidneys at later stages. Subsequently the allantois takes an important part in building up the chorion, from which the fetal contribution to the nutritive apparatus of the placenta is directly derived.

The abdominal stalk is peculiar to the human embryo, in which it very early appears as a pedunculated extension of its caudal portions to the surrounding false amnion, over which it expands and with which it fuses, the

allantoic tissue taking part in the formation of the chorion (Pl. 12, Fig. 1). The allantois in man, therefore, is never free, and finds its expression in the entodermic diverticulum, which passes from the hind-gut through the abdominal stalk toward the chorion.*

Whatever its initial mode of formation, the allantoic tissue grows with rapidity and extends over the inner surface of the false amnion, with which it soon becomes intimately united, the two membranes together constituting the *chorion*, a structure of much importance in providing for the nutrition of the embryo during the last two-thirds of its intra-uterine sojourn, by reason of its active participation in the formation of the placenta.

The allantois being a direct outgrowth or evagination of the primitive gut, its wall consists of an inner entodermic and an outer mesodermic layer—extensions of the splanchnopleuric tissues forming the digestive tube. Coincidentally with the later development of the allantois, blood-vessels extend from the arterial trunks of the embryo within the mesodermic layer of the sac and invade this tissue, which has become closely united with the false amnion in their joint production of the chorion.

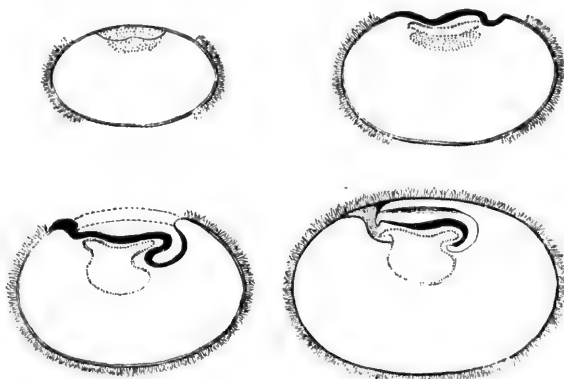


FIG. 75.—Diagrammatic sections representing growth and arrangement of the amnion in the earliest stages of the human embryo (His).

The *chorion*, covered with simple and compound villi, is at first devoid of blood-vessels, and is composed of the ectodermic and entodermic layers on its outer and inner surfaces, between which lies the thicker lamella formed by the fused amniotic and allantoic mesodermic strata. Shortly after the establishment of the chorion, the arteries conveyed by the allantois spread out within the mesodermic layer of the chorion and invade the villi, which then display vascular loops within their characteristic leaf-like, club-shaped processes. These processes often consist of a main primary stalk from which secondary twigs branch, from which diverge the ultimate leaves.

* The term "chorion" is here used in a restricted sense as indicating the membrane resulting from the fusion of the false amnion and the allantoic tissue; by some authors (Minot) the "chorion" represents the entire extra-embryonic somatopleure, which gives rise alike to the true and the false amnion.

The form and arrangement of the villi vary somewhat with the duration of pregnancy: at the third month, or when the placenta is formed, the villi are short, thick-set, and of irregular shape; later they become less irregular, and the secondary branches leave the parent stems less acutely; finally, at full term, the villi are more regularly disposed and their branches have become long and slender and less closely set. The recognition of the villi of the chorion is often a matter of much practical importance, since their presence, as determined by microscopical examination of suspicious matters discharged *per vaginam*, is positive evidence of the existence of pregnancy. Their peculiar arrangement, and their flattened, petal-like form, together with their vascular connective-tissue stroma and epithelial covering, usually suffice to establish the diagnosis.

The Placenta and Decidua.—The primary uses of mechanical protection afforded by the membranes in mammalian embryos are supplemented by the important rôle of assisting in establishing an efficient nutritive organ through which the maternal tissues may extend the necessary aid to the maintenance of the developing animal during the latter two-thirds of its intra-uterine life. Such organ is the placenta, in whose production both fetal and maternal structures take an active part.

The early villi of the chorion are practically identical in all parts where developed. Very soon, however, the villi occupying the area which later will correspond with that of the placenta exhibit unusual growth, and outstrip in size and vigor those of the remaining parts of the envelope. This difference in the development of the villi marks the division of the membrane into the *chorion frondosum* and the *chorion laeve*, the former being that part of the chorion which contributes the fetal portion of the placenta (Fig. 76). The villi of the chorion have undergo gradual atrophy and finally disappear.

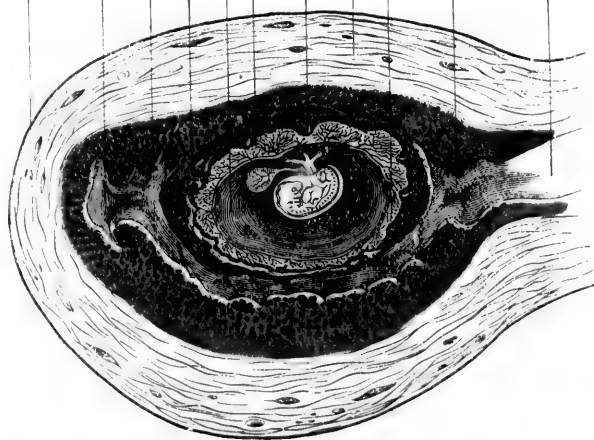
The fertilized ovum on reaching the uterus, after descending the oviduct, becomes entangled and retained within the folds of the soft, thickened mucous membrane prepared for its reception. Immediately after its lodgement, which is usually in the vicinity of the fundus, the uterine mucosa takes steps to secure the imprisonment of the ovum by means of a circular fold which gradually rises around the egg until it is completely enclosed within the new envelope formed by the reflected uterine tissue.

In view of the fact that the mucosa of the uterus is discarded at the close of labor, the thickened uterine lining is appropriately termed the *decidua*; of this membrane three regions are recognized: the *decidua reflexa*, or that portion which encloses the ovum by the reflected folds; the *decidua vera*, or that portion which constitutes the greater part of the general lining of the uterine cavity; and the *decidua serotina*, or that portion of the uterine lining included within the embryonic sac completed by the reflexa (Fig. 76; Pl. 13). The decidua serotina derives especial significance from the fact that it contributes the maternal part in the formation of the placenta.

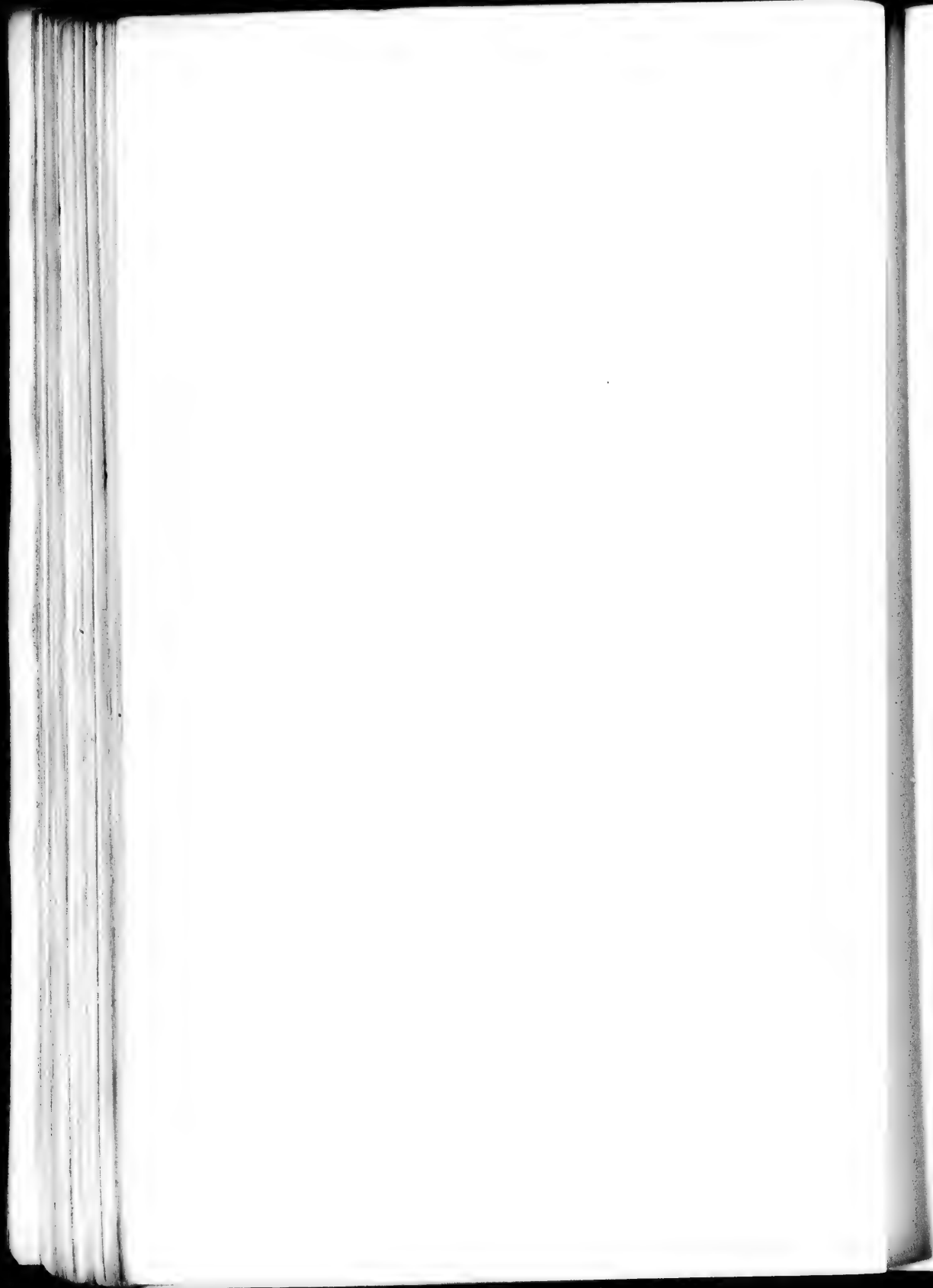
The changes affecting the maternal tissues consist primarily in proliferation of the epithelium and the glands, the latter becoming greatly enlarged both in



Uterine muscle.
 Remains of am-
 niotic vesicle.
 Head of fetus.
 Placental cord.
 Placental vesicle.
 Placental space.
 Placental vein.
 Fetal decidua vera
 and reflexa.
 Chorion.
 Amnion.
 Mesometrium
 of uterus.
 Cavity of uterus.
 Decidua vera.
 Decidua reflexa.
 Cavity of ovum.
 Villi of chorion.
 Decidua sero-
 sity.
 Wall of uterus.
 Chorionic villi.
 Cavity of uterus.
 Cervix.



1. Semi-diagrammatic section of gravid uterus, showing contained ovum of about five weeks (modified from Allen Thompson). 2. Semi-diagrammatic section of uterus, showing relations of fetal and maternal placenta (Ahlfeld).



size and in the number of the tubules, the increase particularly involving their deeper parts. Subsequently the pressure exerted upon this hypertrophied tissue by the rapidly growing embryo and its surrounding structures induces atrophy and degeneration, so that the outermost part of the thickened uterine mucosa becomes the *stratum compacta*, and the middle part the *stratum spongiosum* (Fig. 77). The limited zone embracing the fundi of the tubular uterine glands remains unaffected, and, after the expulsion of the structures

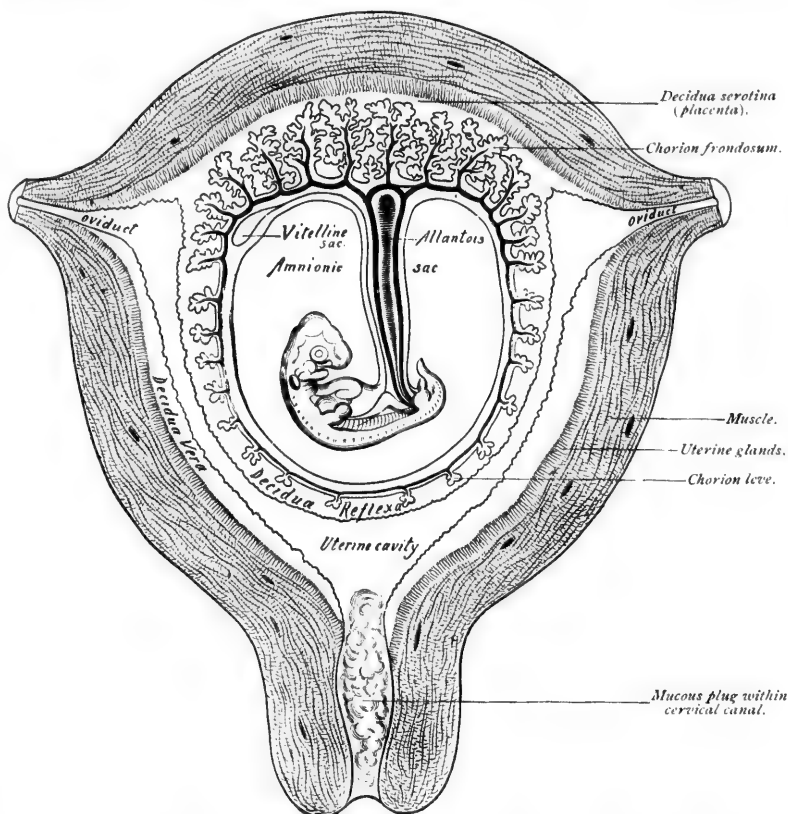


FIG. 76.—Diagram illustrating relations of structures of the human uterus at the end of the seventh week of pregnancy (modified from Allen Thompson).

constituting the after-birth, institutes the processes of repair by which the new mucous membrane of the uterus is produced. As the result of the secondary degeneration of the epithelial portions of the uterine mucosa the vascular chorionic villi are brought into close relations with the vascular connective tissue of the uterus, by which the interchanges between the fetal and maternal circulations are facilitated.

The relations between the fetal and the maternal parts of the placenta, in

the simplest type such as possessed by the hog, consist essentially in the recep-

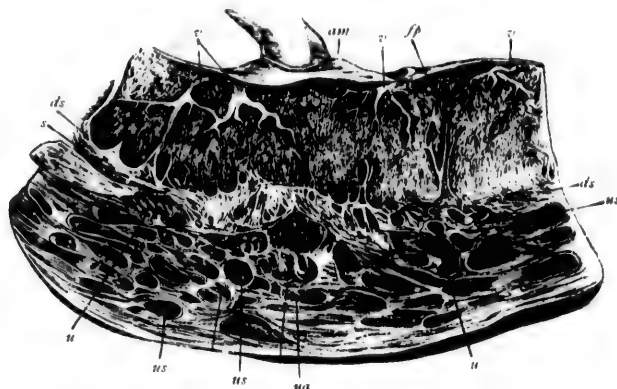


FIG. 77.—Section through uterine wall and attached placenta (Wagner): *u*, uterine wall rendered spongy by greatly-developed uterine sinuses (*us*); *ua*, branches of uterine artery; *ds*, decidua serotina; *s*, line of separation; *fp*, fetal portion of placenta, consisting of a mass of vascular fetal villi (*v.v.v.*), surrounded by the maternal blood-sinuses; *am*, amnion covering free internal surface of placenta.

tion of the simple chorionic villi within corresponding depressions in the



FIG. 78.—Placenta viewed from uterine surface of attachment, showing divisions into cotyledons (Bidloo).

maternal tissues, the circulation of the villi coming into close approximation



with the enlarged blood-vessels of the mother. These simple relations become complicated in the higher mammals and in man by the complex character of the chorionic villi, whose irregular form and disposition are further masked by actual attachments formed between the tips of many large villi and the maternal tissue (Pl. 14).

The disappearance of the epithelial portions of the uterine mucosa brings the fetal villi into close relation with the proliferated connective tissue of the mucosa, with a diminution in the structures separating the fetal and the

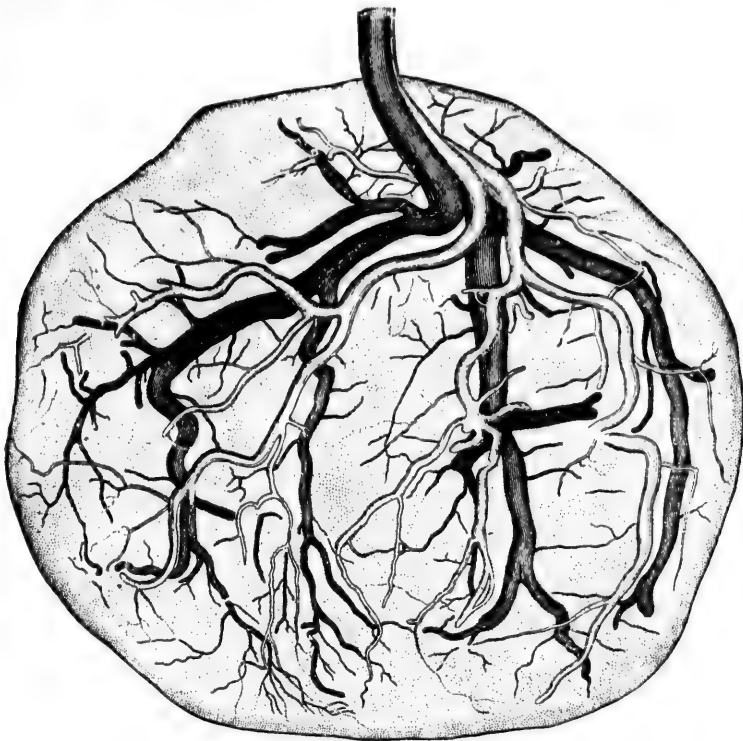


FIG. 79.—Placenta at full term, showing superficial distribution of blood-vessels (Minot).

maternal circulation. Coincidentally with the changes affecting the decidua serotina, the capillary blood-vessels of this part of the uterine mucous membrane undergo enormous expansion, so that finally they are converted into the large and conspicuous blood-spaces occupying the intervals between the attached chorionic villi and the adjacent maternal tissue. These intervillous blood-spaces, the enormously dilated maternal capillaries, are supplied by arterial twigs and are drained by corresponding venous trunks connected with the larger uterine vessels. Notwithstanding the attachment of many large villi, the greater number, comprised by the smaller villi, are not so

bound down, their free ends floating within the large lakes of maternal blood, from which they are separated by the attenuated and atrophic endothelial wall of the space alone.

The human placenta at full term, as seen after the expulsion of the after-birth, is a discoidal mass, usually oval, sometimes circular, but often irregular in outline, about 18 centimeters in diameter and 2.5 to 3 centimeters in thickness. It presents an inner smooth surface, covered by the amnion and looking toward the fetus, and an outer rough, spongy, uterine surface of attachment subdivided by furrows into numerous more or less distinct areas or *cotyledons* (Fig. 78) composed of the lacerated decidual tissue and vessels torn through at the time of the separation of the placenta, the decidua serotina splitting, one part adhering to the outer surface of the placenta, the other remaining attached to the uterine wall. In contrast with the dark blood-clot hue of this tissue, the smooth, shining amniotic surface appears of a generally lighter, somewhat mottled tint, made up of reddish-gray patches alternating with yellowish areas, which depend respectively upon the contained blood and the fetal villi, whose colors shine through the superimposed transparent amnion.

The placental blood-vessels (Fig. 79)—the two umbilical arteries and the single umbilical vein—spread out in all directions from the usually eccentric point of insertion of the umbilical cord, when distended with blood their courses being readily traced both by sight and by touch beneath the overlying amnion. The arterial twigs are more superficial than the veins, which are considerably larger in diameter. Both sets of vessels pass from the smaller to the larger twigs without anastomoses.

Structure.—If the freshly-cut surface of the thickness of the placenta be

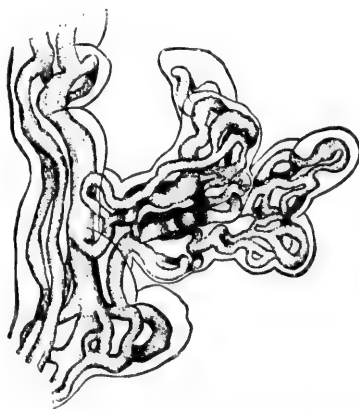


FIG. 80.—Portion of injected villus from a placenta of about five months (Minot).

carefully examined with the unaided eye or with a low magnifying glass, the entire organ is seen to be composed of an inner and an outer membranous boundary, between which is included a thick spongy layer contributing almost the entire thickness of the organ. Closer investigation shows that the spongy layer is composed of the loosely held masses of chorionic villi (Fig. 80), with the intervillous blood-spaces, separated into the cotyledonous areas by connective-tissue septa. The outer membranous boundary consists of the condensed portion of the decidua serotina, which adheres to the fetal villi and supplies the outer wall to the blood-spaces; the inner boundary includes the denser portion of the chorion together with the adherent amnion.

Microscopic examination of the spongy placental tissue, as seen in sections

(Figs. 81, 82), shows the villi, although differing greatly in size, to be made

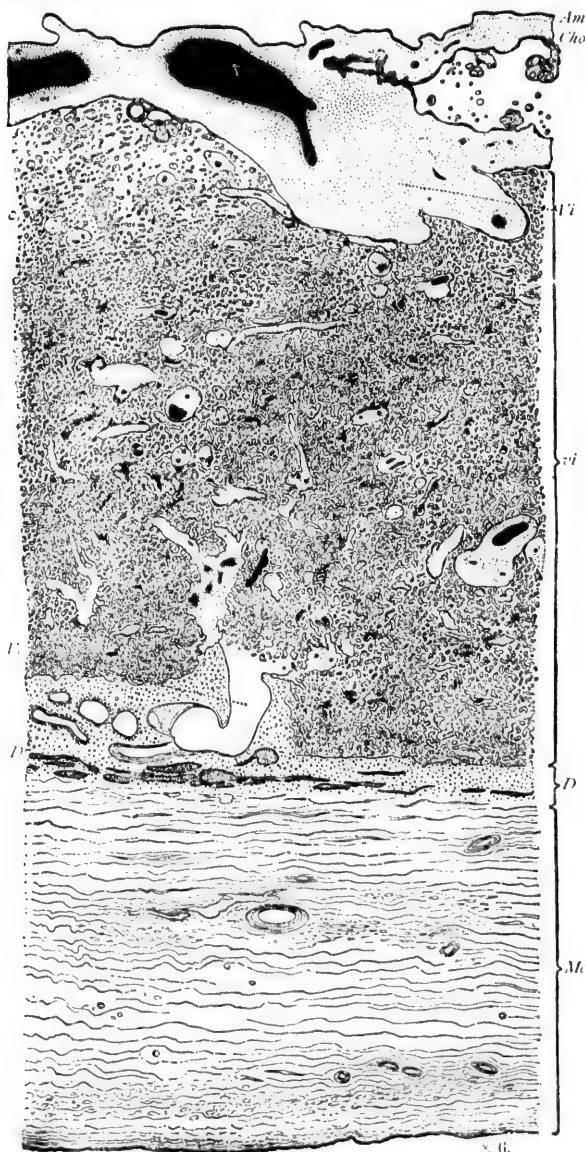


FIG. 81.—Section through placenta of seven months *in situ* (Minot): *Am*, amnion; *Cho*, chorion; *Vi*, root of a villus; *vi*, sections of ramifications of the villi among the maternal blood-spaces; *D*, deep layer of the decidua, showing remains of enlarged glands of stratum spongiosum; *Ve*, uterine blood-vessel connected with placental sinus; *Me*, muscular wall of uterus.

up of a stroma of embryonal connective tissue containing large branched cells

and blood-vessels; these latter consist of the larger twigs, encased by the robust primary stalks, and of all gradations of size to the slender capillary loops supplying the terminal petal-like processes. The exterior of the very young villi is covered by a layer of chorionic epithelium, but this soon becomes less distinct, and after the fourth month it no longer constitutes a continuous layer, but is present only in patches. The ectodermic epithelium covering the cho-

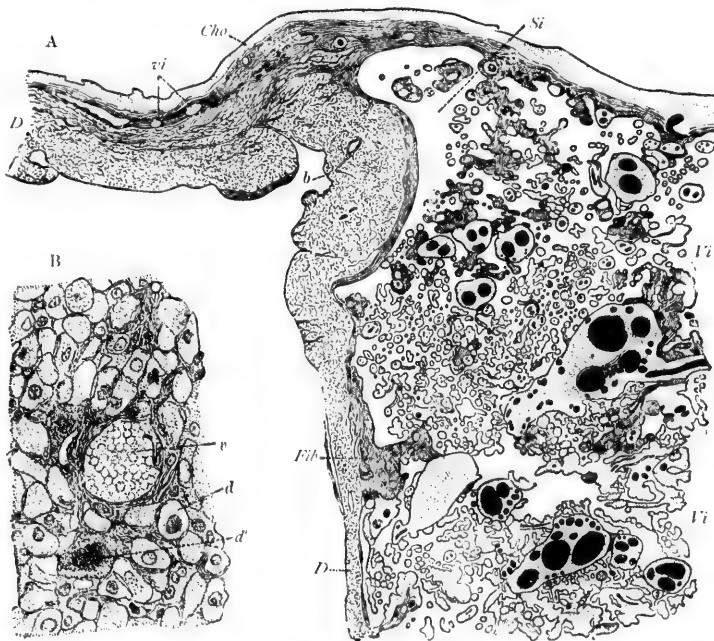


FIG. 82.—A, section through margin of placenta at full term (Minot): *D, D*, deep layer of decidua; *Vi*, chorionic villi variously cut, blood-vessels injected; *Si*, marginal space nearly free from villi; *v*, atrophic extra-placental villi; *Cho*, chorion; *b*, vessel of uterine wall; *Fib*, canalized fibrine derived from modified chorionic ectoderm. B, decidual tissue from placenta at full term; *d, d'*, decidual cells; *v*, blood-vessel.

riion, as described by Langhans, Kastschenko, and Minot, consists of a deep and a superficial stratum, the cells of the latter assuming a flattened, scale-like form.

Sections of the placenta during the later months of gestation fail to reveal any definite endothelial partition between the exterior of the villi and the maternal blood-spaces, the villi seemingly coming directly in contact with the blood of the mother. The determination of the existence or absence of a distinct wall to the blood-space has given rise to much discussion and conflicting assertion. The solution of the question, as so often is the case, seems to be found in the more careful study of the development of the tissues, which study has shown that in the earliest stages the fetal villi are separated from the maternal blood-vessels by an intervening layer of decidua as well as by the endothelium

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of the vessels. With the progressively increasing capacity of the enormously dilated blood-capillaries into the blood-spaces the compression and atrophy of the interposed structures follow—first of the decidua tissues, and finally of the vascular endothelium, during the later months of pregnancy the external surface of the chorion and its villi constituting the immediate wall of the maternal blood-space.

4. **Umbilical Cord.**—The formation of the human umbilical cord is closely related to the primary abdominal stalk. The latter, as already noted, may be regarded as the extension of the embryo—as a sort of pedicle connecting its caudal parts with the chorion and containing the allantoic diverticulum. In the early stages the somatic folds which form the amnion bear the same relation to the abdominal stalk as they do to the more anterior parts of the embryo; later they bend around the stalk to meet and join on its ventral surface, the amnion in consequence becoming separated from the stalk, which thus becomes gradually enclosed within a tubular amniotic sheath. The closure of the somatopleuric folds around the abdominal stalk imprisons the umbilical or vitelline duct within a space which is, in fact, part of the celom. This space soon becomes greatly reduced, and finally is obliterated. The foregoing relations point out the fact, strongly emphasized by Minot, that the umbilical cord is covered with the direct extension of the embryonic somatopleure, and not with the amnion, as is often asserted, since the amnion gradually becomes separated from the embryo along the cord as far as its distal end, where it still remains connected.

The most important constituents of the umbilical cord in its earlier condition are the two umbilical arteries, the two umbilical veins, the allantoic diverticulum, and the extension of the celom containing the vitelline duct and, possibly, traces of the vitelline vessels. Later, the umbilical veins fuse and constitute a single vessel; the allantoic lumen and the celomic space atrophy and disappear. The atrophic vitelline or umbilical duct long remains, even after birth the vesicle and its duct appearing as a minute sac and stalk lying between the amnion and the chorion, in close proximity to the placenta.

The human umbilical cord at birth measures about 55 centimeters (22 inches) in length, with from 15 to 160 centimeters (6 to 64 inches) as the extremes of its variations; its diameter is from 10 to 15 millimeters ($\frac{3}{8}$ to $\frac{5}{8}$ inch). The cord usually joins the inner smooth surface of the placenta eccentrically, its insertion at times being marginal, or, in rarer cases, even altogether outside the immediate area of the placenta. The apparent twisted condition of the cord is often very marked, the spirals, sometimes to the number of thirty or more, being emphasized by the contained blood-vessels. While this phenomenon has long been known, a satisfactory explanation of the twisted appearance, which begins before the third month, still remains to be given, notwithstanding numerous theories and discussions. A point of especial interest, as pointed out by Minot, is that there is no evidence that the entire cord really undergoes torsion, but rather that the blood-vessels become coiled within the soft tissue as the result of an excessive unequal growth still insufficiently understood.

The *structure* of the cord includes an external covering of epithelium directly continuous at its distal end with that of the amnion. The bulk of the cord consists of the peculiar form of embryonal connective tissue known as the *jelly of Wharton*, rich in branched cells with anastomosing protoplasmic processes. Shortly beyond the umbilical opening both capillaries and nerves are apparently wanting; lymphatics, in the sense of definite canals, are also absent. In addition to the large umbilical blood-vessels, epithelial masses indicate the remains of the allantoic diverticulum and the vitelline duct.

5. **Development of the External Form.**—Adopting the divisions suggested by His, it is convenient to distinguish three stages in the development of the human subject. The *stage of the ovum* embraces the first two weeks of gestation, and is occupied by the earliest developmental processes; the *embryonal stage* includes from the third to the fifth week, during which time the characteristic embryonal features are pronounced and the principal organs and symptoms are well established; the remaining weeks of pregnancy are devoted to the *fetal stage*, during which the embryonal characters are gradually replaced by those of the fetus and the full-term child. While it is evident that no sharp demarcation separates these stages, yet certain well-pronounced characteristics distinguish, in general at least, embryos of particular developmental epochs, and consequently serve to determine their probable age notwithstanding individual variation.

Stage of the Ovum.—Opportunities for examining early human ova are rare, the youngest well-authenticated and carefully-observed specimen being the classical ovum of about twelve days described by Reichert (Fig. 83). The

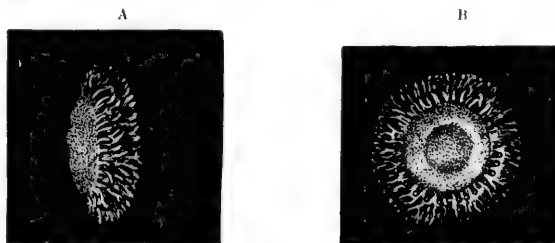


FIG. 83.—Human ovum of about twelve days (Reichert): A, front view; B, side view. The villi are seen to be limited in distribution, leaving the poles free.

appearance of this ovum emphasizes the early and precocious development of the villi which encircle the flattened lenticular vesicle (5.5 millimeters in its greatest diameter by 3.3 millimeters in thickness) as a closely set equatorial zone. Of the embryo proper no trace was discoverable, a patch of thickened cells alone representing the embryonal area. The earlier processes of segmentation and blastulation have never been observed in the human ovum.

Stage of the Embryo.—The thirteenth and fourteenth days witness the evolution of the early embryonal form as effected by the development of the medullary groove and canal and their cephalic expansion. The embryo is attached by the allantoic stalk to the surrounding membranes, the axes of the

stalk and the upright embryo generally coinciding (Figs. 84, 85; see also Fig. 97); what flexure exists at this time is backward, and results in a concave dorsal outline. The ventral aspect of the embryo of this stage is largely occupied by the relatively huge vitelline sac, which freely communicates with the imperfectly defined gut along almost the entire length of the embryo. The precociously developed amnion has completely enveloped the embryo and its stalk as far as the distal attachments of the latter. The heart is first represented by two longitudinal folds corresponding with the primary halves from which

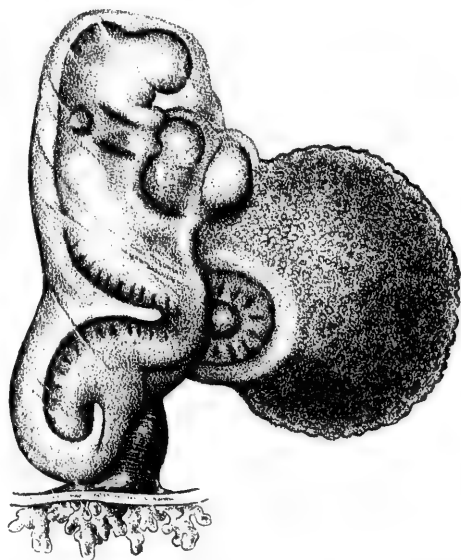


FIG. 84.—Human embryo of about the fifteenth day (His): the embryo is attached to the wall of the blastodermic vesicle by means of the umbilical or allantoic stalk, and is enclosed within the amnion; the large vitelline sac freely communicates with the still widely open gut.

the organ is formed; slightly later, these folds fuse into a single heart, which then appears as a conspicuous projection between the yolk-sac and the cephalic vesicle.

The third week (Fig. 86) is productive of many important additions to the exterior of the embryo. Its form becomes more definite; the brain-vesicles, together with the optic vesicles and the auditory sacs, are differentiated; the visceral arches and the corresponding furrows are formed; the yolk-sac is much more constricted, and its narrower connection with the gut foreshadows the later vitelline stalk. By the twenty-first day the first rudiments of the limbs appear.

The fourth week (Fig. 86) is marked by great increase in size and by conspicuous changes which give to embryos of this age distinctive features, growth being relatively more active at this period than at any other. With the termination of the third week the embryo is still erect. During the next day flexion takes

place with great rapidity, so that during the twenty-third day the cephalic and caudal poles of the embryo actually meet or even overlap, the dorsal outline approximating a circle (Figs. 86, 87). The individual brain-vesicles are better developed, as are also the visceral arches and furrows, the eyes, ears, and nose; the heart has increased in size, and the limb-buds have become more pronounced. At the end of the twenty-third day extreme flexion has taken place, from which time until the close of the fourth week the embryo gradually becomes less tightly coiled on itself, the larger and more conspicuous head slowly rising and leaving the tail.

During the latter half of the fourth week, in addition to the increased development of the visceral arches, the individual cephalic flexures become

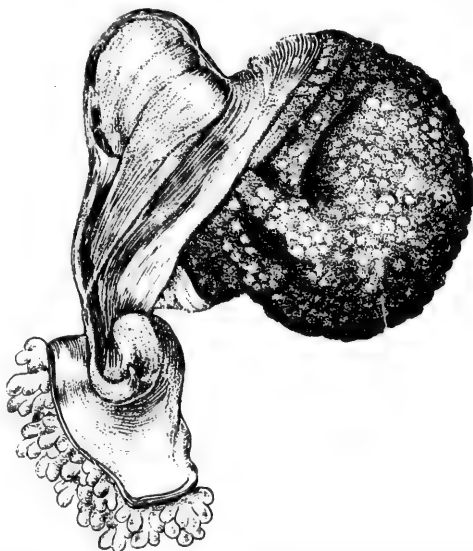


FIG. 85.—Human embryo of about the thirteenth day (His): the caudal pole of the embryo is connected with the blastodermic vesicle by means of the abdominal or allantoic stalk; the amnion already completely encloses the embryo, and the large vitelline sac communicates throughout the greater part of the ventral surface by means of the unclosed gut-tract.

very conspicuous. These flexures consist of a sharp bending of the anterior parts of the head upon the posterior half, resulting in a change of nearly 90° in the cephalic axis, with the production of a conspicuous prominence marking the position of the mid-brain. Posteriorly, the cervical flexure sharply indicates the junction of the cephalic and trunk segments; farther caudally, the dorsal and coccygeal flexures mark less pronounced changes in the direction of the embryonic axis. On either side of the dorsal mid-line, extending from the cervical flexure to the tip of the caudal extremity, a series of prominent quadrilateral areas indicate the position of the somites or vertebrae (Fig. 86, 11 and 12).

The development of the *visceral arches* reaches its highest expression by the

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termination of the fourth week, when the series of arches is seen in its best condition (see Fig. 129). In man and in mammals five arches are successively developed from before backward, the last, however, being scarcely differentiated and very inconspicuous. The first arch when fully formed is partially divided into an upper and a lower secondary division, the *maxillary* and *mandibular processes*,

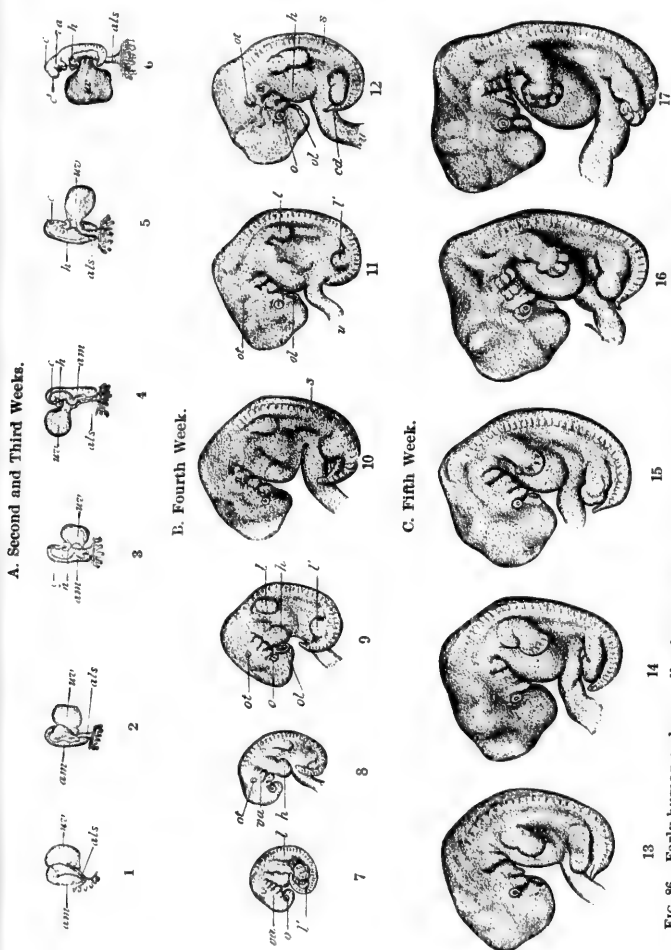


FIG. 86.—Early human embryos, all enlarged about two and a half times (H18): 1-4, from twelfth to fifteenth day; 5, 6, from eighteenth to twenty-first day; 7, 8, from twenty-third to twenty-fifth day; 9-12, from twenty-seventh to thirtieth day; 13-17, from thirty-first to thirty-fourth day. *am*, amnion; *ar*, unbilobed or vitelline vesicle; *h*, heart; *vis*, visceral arches; *o*, otic vesicle; *ol*, olfactory pit; *l*, *l'*, upper and lower extremities; *s*, somites; *u*, primitive umbilical cord.

so called from the parts to whose construction they respectively largely contribute. The maxillary processes of the first arch, in connection with the intervening *naso-frontal process*, contribute the parts which eventually become the upper boundaries of the oral cavity; the mandibular processes of the same arch join to form the lower boundary of the month. During the fifth week the margins of the centrally projecting *naso-frontal plate* differentiate into two

secondary processes, the *processus globulares*, forming the inner borders of the nasal pits, and the *lateral frontal processes*, which contribute the outer wall of the nasal fosse and separate these depressions from the eyes. These processes normally unite to form the continuous structures around the nose and the mouth.

Faulty union or imperfect closure of the intervening fissures gives rise to the varieties of hare-lip and cleft palate and to other forms of congenital facial defects. The *second* or *hyoid arch*, as well as the third, fourth, and fifth arches, eventually fuses with its neighbors and loses its identity; a similar fate awaits the intervening outer visceral furrows or "clefts," with the excep-

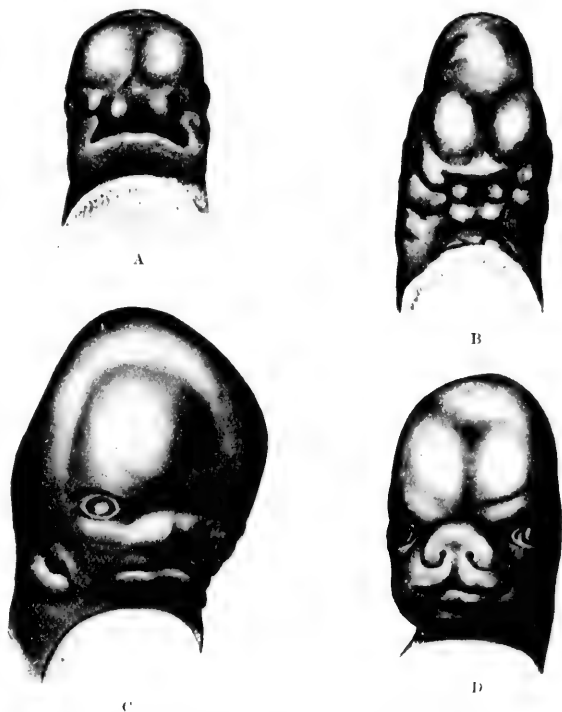


FIG. 87.—Development of the face of the human embryo (His): A, embryo of about twenty-nine days. The naso-frontal plate differentiating into *processus globulares*, toward which the maxillary processes of first visceral arch are extending. B, embryo of about thirty-four days: the globular, lateral, frontal, and maxillary processes are in apposition; the primitive opening is now better defined. C, embryo of about the eighth week: immediate boundaries of mouth are more definite and the nasal orifices are partly formed, external ear appearing. D, embryo at end of second month.

tion of the first, since they gradually become obliterated by the fusion of the surrounding arches. The first outer furrow, or *hyomandibular cleft*, contributes largely to the formation of the external auditory canal, while the surrounding portions of the mandibular and hyoid arches contribute the tissue from which the external ear is derived.

The Second Month.—The fifth and sixth weeks (Figs. 86, 88) add to the size and the general advanced development, although the phenomenal rate of growth of the preceding week is replaced by more gradual increase. The limbs constitute the most characteristic features of this period, since what prior to the fifth week were but rudimentary limb-buds now undergo differentiation into distinct segments, at first two, then three. Toward the close of the fifth week the flattened terminal segments representing the future hands and feet exhibit distinctions as thin marginal plates and thicker proximal portions. The marginal areas very soon exhibit traces of the digits as small elevations separated by shallow grooves which gradually extend toward the free ends. The fore limbs appear slightly earlier than the hind limbs, and retain this lead throughout their development. By the middle of the sixth week the fingers are sufficiently developed to project beyond the hand, although the toes are

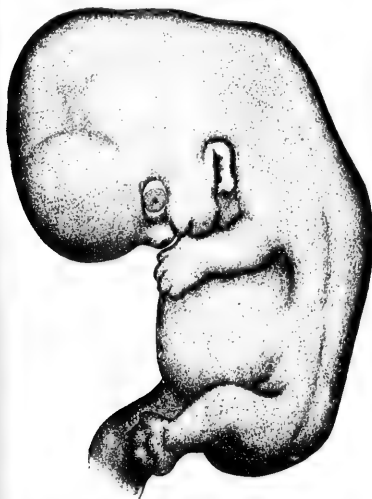


FIG. 88.—Human embryo of about six weeks, enlarged five times (H.S.).



FIG. 89.—Human embryo of about seven weeks, enlarged five times (H.S.).

just beginning to be outlined, and represent a stage of ten to fourteen days later. Coincidentally with these changes the general development of the embryo has steadily progressed (Fig. 89), with the result of supplanting the embryonal characteristics by those of distinctly fetal type. The head, though proportionately large, has become partially once more raised; the boundaries of the mouth have become definitely located; the external parts of the eye, the ear, and the nose are well advanced; and the general contour of the trunk has assumed more of the characters of the child.

The second month witnesses the disappearance of the cervical flexion and

the further lifting of the head, which is still very large (Fig. 90). The face shows distinct advancement toward its completed type, although the nose is yet unduly broad, and indications of the fissures surrounding the mouth are discernible. The limbs project from the body, and the fingers, including the differentiated thumb, and the toes are well defined. By the close of the second



FIG. 90.—Human embryo of about eight and a half weeks, enlarged five times (His).

month the fetus measures from 25 to 30 millimeters (1 to $1\frac{3}{8}$ inches) in length and weighs from 15 to 20 grams.

The Third Month.—The third month establishes the human form, although the head still unduly preponderates. The limbs have acquired their definite shape, and the imperfect nails are present on both fingers and toes. During this month the external organs of generation become definitely differentiated,

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although they make their appearance several weeks earlier. At the end of this period the fetus measures about 7 centimeters ($2\frac{3}{4}$ inches) in length and weighs about 120 grams (4 ounces).

The Fourth Month.—Short hairs, devoid of pigment, appear on the scalp and on some other parts of the body, which is now covered with firmer skin of rosy hue. The eyelids, nostrils, and lips are closed. The anus opens, and the coils of intestine, which before extended into the umbilical cord, now lie entirely within the abdominal cavity. The point of emergence of the umbilical cord lies low down, close to the pubes. The head forms about one-fourth of the entire body; the bones of the skull, while ossifying, are still widely separated. The sexual distinctions of the external organs are well defined. At the end of this period the length of the fetus has increased to about 12.5 centimeters (5 inches), and its weight to between 230 and 240 grams ($7\frac{3}{4}$ ounces).

The Fifth Month.—The heart and the liver share with the head in the undue preponderance which these parts present. The contents of the small intestine—the meconium—show traces of bile, being of a pale yellowish-green color. The lower extremities are now longer than the arms; the nails are well formed. Hairs are more plentiful, but are devoid of color. At the termination of this month the fetus measures 20 centimeters (8 inches) in length and weighs about 500 grams (1 pound). The fetal movements are now distinctly felt by the mother.

The Sixth Month.—The surface presents many wrinkles and a dirty-reddish hue; the sebaceous coating, the *vernix caseosa*, begins to appear. This whitish substance is composed of the dead and shed surface-epithelium, mingled with the secretions of the sebaceous glands; its primary function is the protection of the fetal integument from maceration by the amniotic fluid. Eyebrows and eyelashes begin to grow. The length of the fetus by the end of this period has increased to 30 centimeters (12 inches), and its weight to about 1 kilogram or 1000 grams (2 pounds).

The Seventh Month.—The continued deposition of subcutaneous fat causes a general appearance of greater plumpness, although the surface is still somewhat wrinkled; hairs about 5 millimeters ($\frac{3}{16}$ inch) in length; eyelids are now permanently open. The liver is still relatively large; meconium occupies the entire large intestine; the testicles have descended as far as, or even into, the inguinal canals. Children born at the end of this period may survive, although they usually succumb. The fetus now measures about 35 centimeters (14 inches) and weighs about $1\frac{1}{2}$ kilograms (3 pounds).

The Eighth Month.—This and the succeeding month are occupied by increase in bulk rather than by great gain in length. The skin assumes a brighter flesh-color; the scalp is plentifully supplied with hair; the nails almost reach the finger-tips. The *vernix caseosa* forms a complete coating; the lanugo, or embryonal down, begins to disappear. The subcutaneous fat has increased, giving less harsh outlines to the body. The close of this month finds the fetus measuring about 40 centimeters (16 inches) and weighing from 2 to $2\frac{1}{2}$ kilograms (4 to 5 pounds).

The Ninth Month.—The fetus at full term presents usually a well-rounded

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body, from which the lanugo has almost entirely disappeared. The skin is less highly colored, and is covered in places, particularly the head, the axilla, the groin, and the flexor surfaces, with a layer of protecting *vernix*. Both testicles have descended into the scrotum; in the female the labia majora are in contact. The intestinal tract contains the dark-greenish-colored *meconium*, consisting of the secretions of the intestines and the liver mixed with the epi-

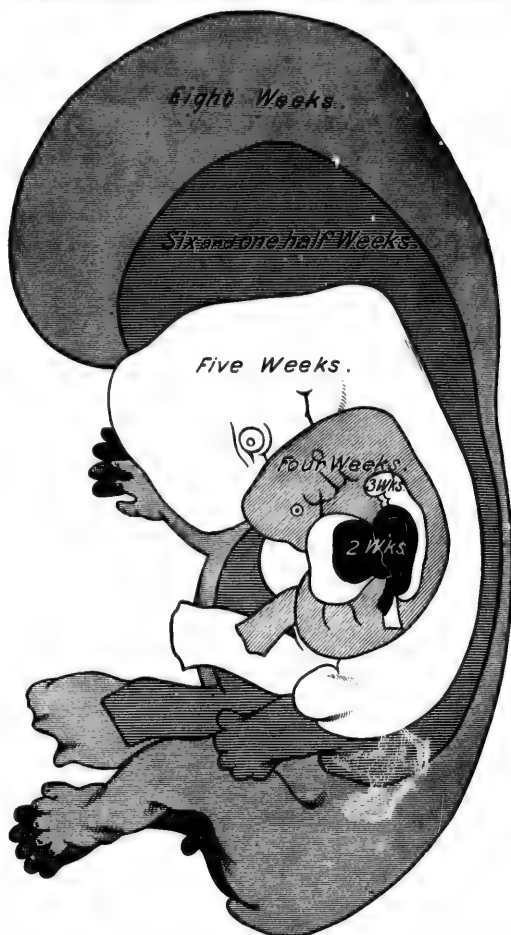


FIG. 91.—Diagram illustrating the outlines of the human fetus at various stages, from the end of the second to the end of the eighth week, magnified five times (modified after Mell).

thelium from the digestive tube, together with epidermis and lanugo swallowed by the fetus. The umbilicus has reached a position almost exactly in the middle of the body. The first epiphyseal ossification to appear, that of the lower end of the femur, is often the only one present, but ossification may have commenced also in the upper epiphyses of the tibia and the humerus.

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A convenient simple method of determining the approximate length of the fetus at any period during gestation has been given by Haase. The length in centimeters may roughly be estimated up to the end of the fifth month by *squaring* the month; beyond the end of the fifth month, by *multiplying* the month by the common coefficient 5.

Computed by this method, the approximate greatest or entire lengths of the fetus for the several months are:

At the end of	1 month	the length =	$1 \times 1 = 1$	centimeter =	$\frac{3}{8}$ inch.
"	"	2 months	" = $2 \times 2 = 4$	centimeters =	$1\frac{1}{2}$ inches.
"	"	3 "	" = $3 \times 3 = 9$	"	$3\frac{3}{4}$ "
"	"	4 "	" = $4 \times 4 = 16$	"	$6\frac{3}{4}$ "
"	"	5 "	" = $5 \times 5 = 25$	"	10 "
"	"	6 "	" = $6 \times 5 = 30$	"	12 "
"	"	7 "	" = $7 \times 5 = 35$	"	14 "
"	"	8 "	" = $8 \times 5 = 40$	"	16 "
"	"	9 "	" = $9 \times 5 = 45$	"	18 "
"	"	10 "	" = $10 \times 5 = 50$	"	20 "

The full-term fetus measures, on an average, about 50 centimeters (20 inches) in its entire length, and weighs from 3 to $3\frac{1}{2}$ kilograms (from 6 to 7 pounds), the average weight for boys being 3340 grams (7 pounds, 6 ounces), and that for girls 3190 grams (7 pounds). The individual variations in weight of new-born children include a wide latitude, as indicated by the extremes of 717 grams (1 pound, $9\frac{1}{4}$ ounces) and 6123 grams (13 pounds, 8 ounces), as accepted by Vierordt. Children really exceeding 5 kilograms (about 10 pounds at birth) are very rare, notwithstanding numerous reputed cases. Waller, however, reports a case of a living infant, delivered by him with forceps, that weighed 15 pounds 15 ounces! In addition to sex, boys being heavier than girls, the size of the child is materially influenced by the conditions of maternal parentage; thus: (1) Young mothers have the smallest children, and mothers between thirty and thirty-five years have the heaviest. (2) The weight of the child increases with the number of previous pregnancies, providing that the successive children are of the same sex and that the pregnancies do not follow too rapidly; the children of primiparæ, therefore, average less than those of multiparæ. (3) The weight of the child increases with the weight (Gassner) and the length (Frankenhaüsen) of the mother. In addition, obviously, all causes adversely affecting the physical condition of either parent may exert an unfavorable influence on the vitality and development of the fetus.

6. Development of the Circulatory System.—The vascular system is formed by the development of two parts, at first entirely distinct—the extra-embryonic blood-vessels, and the central circulatory apparatus represented by the heart and the great primary trunks. The extra-embryonic blood-vessels constitute successively two distinct systems, the *vitelline* and the *allantoic circulation*. The first of these in mammals and in man is comparatively unimportant; the second is of the utmost importance, since it takes an active part in securing the nourishment of the embryo from the maternal tissues by means of the formation of the placental circulation which it becomes.

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Very early in the development of the embryo the germinal area becomes mottled by the appearance at its periphery of an irregular network of branching patches of darker tint than the surrounding tissue, due to the active cell-proliferation. These patches are the *blood-islands of Pander*, so called from the active rôle played by them in the production of vascular tissue—vessels and blood-cells. By the extension of the blood-islands and the newly-formed vessels the circulation within the *area vasculosa* (Pl. 15) rapidly extends centrally and toward the embryo, with which communication is later established by the vitelline arteries and veins, large trunks which connect with the cephalic and caudal extremities respectively of the primitive circulatory apparatus which has meanwhile been developed within the embryo. The significance of the vitelline circulation in mammals is probably merely suggestive of its far greater importance in the lower types, where absorption of nutritive materials from the large and conspicuous yolk constitutes an evident reason for its development. In man and in mammals it is doubtful whether the vitelline circulation contributes nutritive substances in any appreciable degree.

Coincidentally with the decrease in the yolk-sac and its vitelline circulation, the vessels supplying the allantoic tissues become more prominent, the growth of the two systems proceeding in inverse order. The conversion of a portion of the vascular chorion into the fetal contribution of the placenta advances the importance of these vessels to that of the placental circulation, as first represented by the two umbilical veins and the two umbilical arteries, the latter the direct continuations of the intra-embryonic hypogastric arteries. Later, the two veins fuse within the allantoic stalk, thereby producing a single venous trunk which accompanies the arterial stems. Within the body of the fetus, however, the umbilical veins, which there remain separate, develop unequally, the right suffering atrophy and finally disappearing, while the left increases in size and persists until birth as the important umbilical vein conveying the blood to the liver.

The Heart.—Coincidentally with the formation of the primary extra-embryonic blood-vessels within the vascular area, the heart early begins its develop-

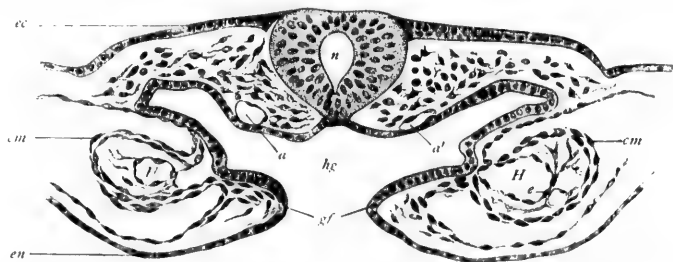


FIG. 92.—Section of early embryo of rabbit (Piersol), showing two separate heart-tubes (*H*, *H'*); *ec*, primitive endothelium; *cm*, mesoderm forming cardiac wall; *ec*, ectoderm; *en*, entoderm; *gf*, folds producing ventral wall of gut-tract; *hg*, head-gut; *a*, *a'*, primitive aorta; *n*, neural canal.

ment. The first trace of this important organ appears as a folding off and hollowing out of a limited mesodermic area on each side; the two heart-tubes

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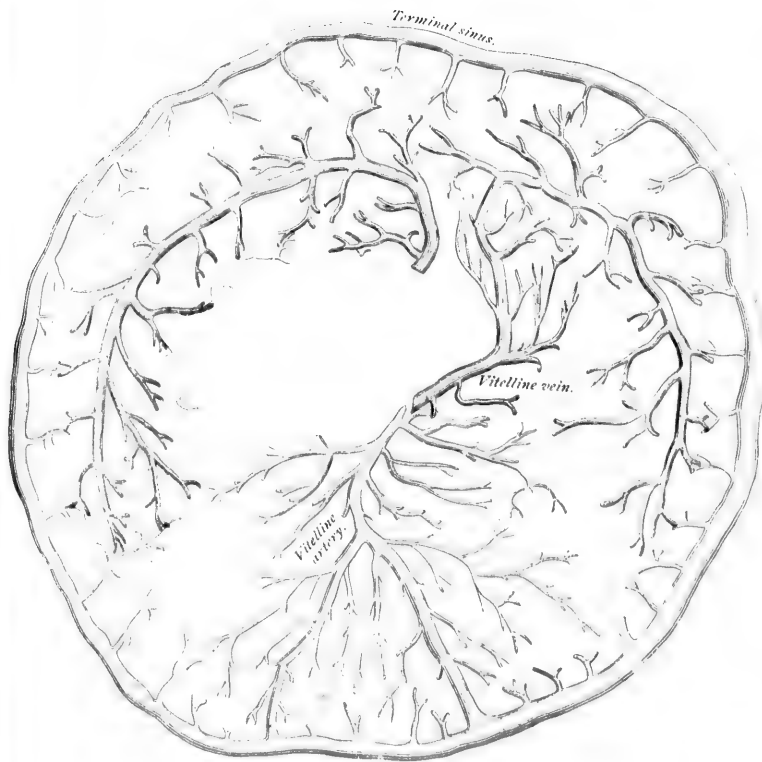
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Vascular area of eleven-day rabbit embryo (E. v. Beneden and Julhan); capillaries not shown: the terminal sinus is seen to be arterial.

thus formed lie within the splanchnic mesoderm and are at first widely separated from each other (Fig. 92). With the bending together and approximation of the visceral layers in the formation of the gut-tract the heart-tubes are brought into apposition, and finally fuse, the union resulting in the production

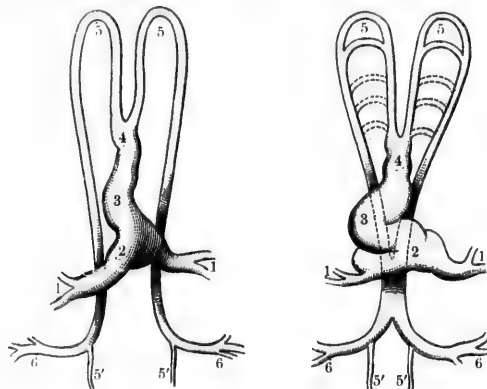


FIG. 93.—Diagrams illustrating arrangement of primitive heart and aortic arches (modified from Allen Thompson): 1, vitelline veins returning blood from vascular area; 2, venous segment of heart-tube; 3, primitive ventricle; 4, truncus arteriosus; 5, 5', upper and lower primitive aorta; 5', 5', continuation of double aorta as vessels to caudal pole of embryo; 6, vitelline arteries returning blood to vascular area.

of a short, straight receptacle, into the caudal end of which empty the vitelline veins, and from the cephalic extremity pass the primitive arterial trunks (Fig. 93).

This early straight heart-tube, lying attached to the floor of the pharyngeal region, is very transient, since the rapidly increasing length of the organ, its

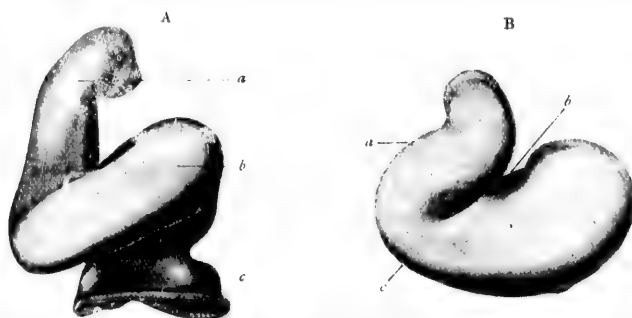


FIG. 94.—A, heart of human embryo of 2.15 mm. (His); a, truncus arteriosus; b, primitive ventricle; c, venous segment. B, heart of human embryo of about 3 mm. (His); a, truncus arteriosus; b, venous segment (behind); c, primitive ventricle (in front).

ends being relatively fixed, soon necessitates flexion, which takes place in both sagittal and transverse planes, and results in giving to the tube the S-form. The lower and posterior limb of the heart receives the great veins and is the *sinus venosus* (Fig. 94); the lower and anteriorly directed loop is the auricular

or venous compartment; the upper and posteriorly directed loop is the ventricular or arterial compartment; the upper limb is the *truncus arteriosus*, from which arise the primitive *aortic arches*. The heart, therefore, at this stage—about the fourteenth day—consists essentially of two imperfectly separated

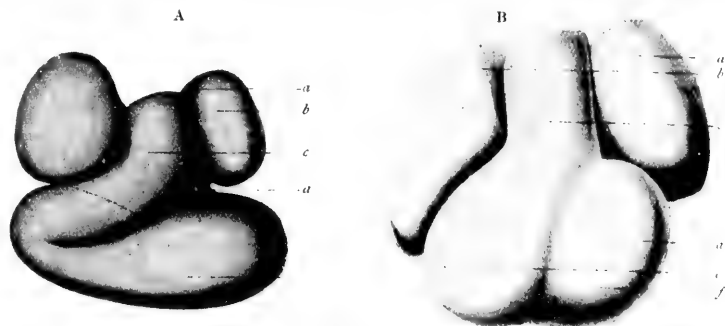


FIG. 95.—A, heart of human embryo of about 4.3 mm. (His): a, atrium; b, portion of atrium corresponding with auricular appendage; c, truncus arteriosus; d, auricular canal; e, primitive ventricle. B, heart of human embryo of about the fifth week (His): a, left auricle; b, right auricle; c, truncus arteriosus; d, interventricular groove; e, right ventricle; f, left ventricle.

divisions—a lower and posterior venous chamber and an upper and anterior arterial compartment—into and from which pass the larger primitive venous and arterial trunks.

The venous or auricular division during the third week develops two con-

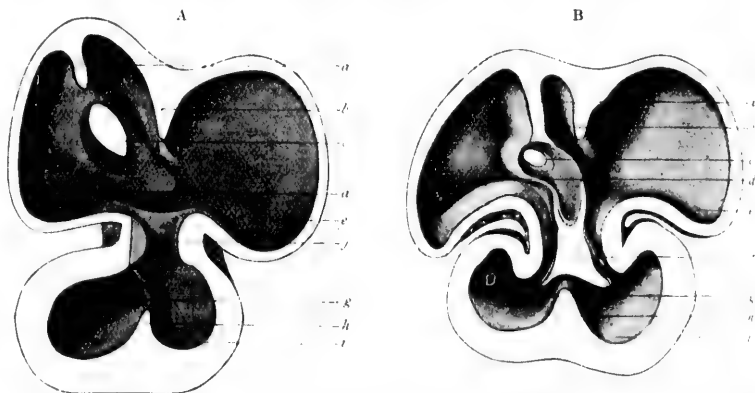


FIG. 96.—A, section of heart of human embryo of 10 mm. (His): a, septum spurium; b, interauricular septum; c, mouth of sinus reuniens; d, right auricle; e, left auricle; f, auricular canal; g, right ventricle; h, interventricular septum; i, left ventricle. B, section of heart of human embryo of about the fifth week (His): a, septum spurium; b, auricular septum; c, opening of sinus reuniens (leader passes through foramen ovale); d, right atrium; e, left atrium; f, septum intermedium; g, right ventricle; h, interventricular septum; i, left ventricle.

spicuous lateral dilatations which assume a position above and behind the growing arterial chamber. These dilatations are the *auricular appendages* (Fig. 95), which for some time are the most conspicuous parts of the auricles. At this

time the auricular and ventricular portions of the heart are imperfectly separated by a marked constriction, the *canalis auricularis*.

During the fourth week the conversion of the single into a double heart commences by the gradual growth of partitions from above downward within the auricle, and from below upward within the ventricle (Fig. 96, A); in addition, the primitive auriculo-ventricular canal becomes divided by the formation of an especial partition, the *septum intermedium*. The division of the heart-chambers progresses to complete separation, with the exception of an orifice in the lower part of the interauricular septum, which orifice remains until shortly after birth as the *foramen ovale*. The entrance of the venous blood into the auricular compartment is effected for some time through the single opening of the sinus venosus. Guarding this orifice are folds of the cardiac lining, one of which folds becomes prominent as the Eustachian valve, directing the blood-current through the foramen ovale. Later, the sinus venosus becomes included within the wall of the heart, and the three principal venous trunks emptying within the sinus—the two ducts of Cuvier and the primitive inferior vena cava—open directly into the auricular cavity by as many separate orifices; that of the left Cuvierian duct is represented by the mouth of the coronary sinus, which this trunk eventually becomes. The truncus arteriosus, the anterior primary arterial trunk, undergoes an independent division by the formation of the *aortic septum*, the partition beginning at some distance from the heart and approaching the latter from above downward. The vessels resulting from the division of the single truncus arteriosus afterward become the aorta and the pulmonary artery, and are limited respectively to the left and right halves of the ventricular compartment by the simultaneously developed inter-ventricular septum.

The primitive heart, as well as the earliest blood-vessels, consists of a double wall, the outer layer representing the muscular and fibrous tissue, and the inner layer representing the endothelial lining. These two coats are for a time entirely distinct, the endothelial heart representing the general arrangement and division of the organ, and lying within the surrounding layer as a shrunken cast within a mould (see Fig. 105). The interval separating the endothelial from the muscular heart later becomes bridged by numerous connecting bands of tissue, the network of trabeculae becoming closer and the intervening spaces smaller as development progresses. The consolidation of the cardiac walls, however, never is completely accomplished, indications of its imperfections being clearly seen in the arrangement of the conspicuous *columnae carneae* of the adult organ, in which the more or less isolated bands represent the thickened remains of the bridging trabeculae connecting the endothelial heart with the denser surrounding capsule.

Arteries of the Fetus.—The early arterial circulation of the fetus differs in many details from that of the later stages. Conspicuous among these differences is the development of the series of aortic arches which extend from the anterior end of the truncus arteriosus around the primitive pharynx, within the visceral arches, and converge into the dorsal longitudinal vessels,

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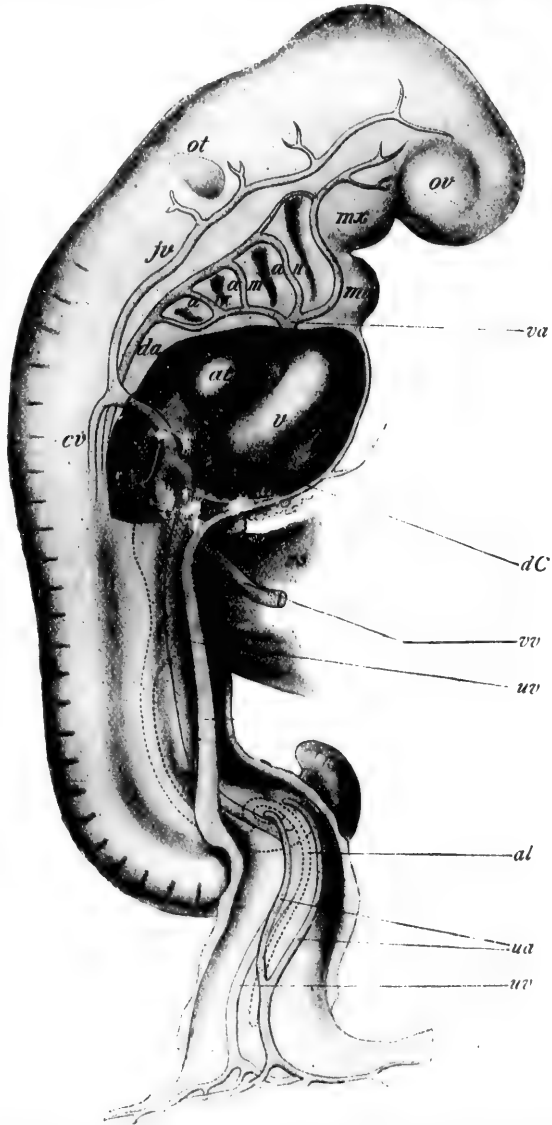


FIG. 97.—Human embryo of about three weeks, showing visceral arches and furrows and their relations to aortic arches (His): *mx, mn*, maxillary and mandibular processes of first visceral arch; *a 1-a 4*, first to fourth aortic arches; *ju, cv*, primitive jugular and cardinal veins; *dC*, duct of Cuvier; *at, v*, atrium and ventricle of primitive heart; *vs*, vitelline sac; *va, da*, ventral and dorsal aortae; *ov, ot*, optic and otic vesicles; *ur, ua*, umbilical veins and arteries; *vr*, vitelline vein; *al*, allantois.

formed, the first pair lying within the corresponding mandibular arch, the last

figs. 93, 97) are

within the tissues of the imperfectly defined fifth visceral bow. The first pair earliest appears and soonest disappears, all five at no time being found simultaneously fully developed, since by the twentieth day, when all are present, the anterior arches have already partly atrophied. These aortic arches in man and in mammals transiently represent the branchial circulation of gill-bearing types; their identity in the higher animals is lost in the metamorphosis which they undergo in the development of permanent trunks.

The fate of the several aortic arches and their relations to persistent structures is briefly as follows (Fig. 98):

(1) The first or mandibular aortic arch early in the fourth week loses its middle segment, the anterior limb taking part in the formation of the external

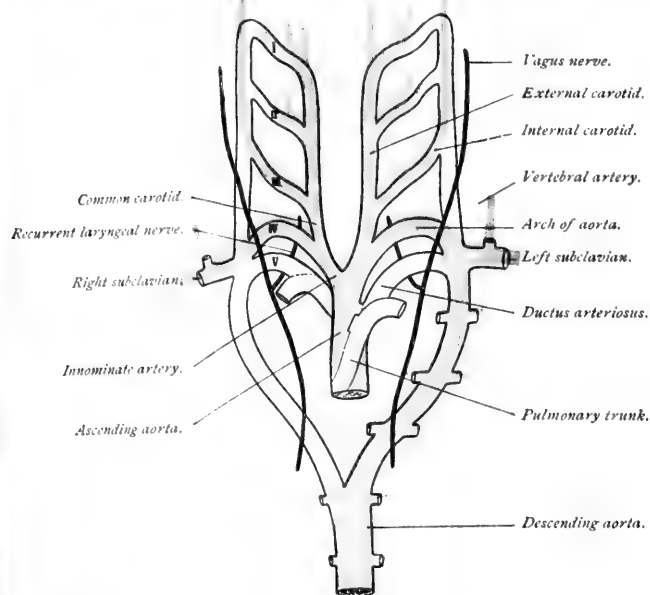


FIG. 98.—Diagram illustrating the fate of the aortic arches in mammals and man (modified from Rathke).

carotid artery and its branches; the posterior or aortic limb aids in forming the internal carotid artery.

(2) The second arch has a fate identical with that of the first, its straighter ventral and dorsal limbs taking part in producing the carotids.

(3) The third arch, which remains almost complete, gives rise to the connection between the external and internal carotid arteries, to the latter of which the arch particularly contributes.

(4) The fourth arch undergoes important changes resulting in its retention on the two sides, since from it are largely derived the innominate, together with the subclavian and vertebral arteries on the right side, and the important arch of the aorta on the left.

and furrows and their relations to the first visceral arch; a 1-a 11, list of Cuvier; at, v, atria, ventricles; ot, optic and other.

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(5) The fifth arch is devoted to the production of the pulmonary arteries, a small portion of the right arch persisting as the right pulmonary artery, and a larger part of the left giving origin to the corresponding pulmonary artery and the ductus arteriosus.

During the fifth week, as before noted, the truncus arteriosus undergoes division into two tubes by the formation of the aortic septum; the resulting aortic tube retains connection with the fourth arch, becoming the ascending portion of the arch of the aorta, while the right tube becomes connected with the fifth arch and forms the pulmonary vessel.

The two primitive aortæ for a time extend on each side of the notochord as longitudinal vessels which almost completely terminate in the large omphalomesenteric or vitelline arteries supplying the circulation of the yolk-sac, the early continuation of the aortic stems being slender, relatively insignificant branches which extend toward the caudal pole of the embryo. With the development of the earliest allantoic structures the posterior segments of the two primitive aortæ unite to form a single trunk, the dorsal aorta, the fusion beginning about the junction of the cervical and thoracic regions and proceeding caudally. At a slightly later period the aortic trunk divides, at the end of the lumbar region, into the allantoic arteries, which pass along the allantoic stalk and are distributed to the chorion, and later to the fetal placenta; they are then known as the *umbilical* arteries as far as the body-wall, being continued within the embryo as the *hypogastrics*. The primitive allantoic arteries eventually become the common and the internal iliac arteries, the external iliacs being formed as new branches when the limbs are developed. After birth, when the fetal placental circulation ceases, the distal parts of the hypogastrics beyond the bladder atrophy and remain as solid fibrous cords passing to the umbilicus; the proximal parts of these vessels retain their lumina and persist as the superior vesical arteries.

Veins of the Fetus.—Toward the close of the embryonal period, about the fourth week, the venous arrangement includes three distinct sets of vessels returning the blood to the heart (Pl. 16); these are—(1) The Cuvierian veins, returning the blood from the body of the embryo; (2) the vitelline veins, returning the blood from the circulation of the yolk-sac; (3) the allantoic, later the umbilical, veins, returning the blood from the chorion and the developing placental structures. The early systemic veins consist of an upper trunk, the *anterior cardinal* or primitive jugular veins, by which the blood from the head is carried to the heart, and the *posterior cardinals*, collecting the blood from the trunk and the important Wolffian bodies. These vessels, along with the vitelline and allantoic veins, pour their blood into a common receptacle, the *sinus venosus*, which opens directly into the primary auricular division of the heart. For a short time these veins are about equal in size and are evenly developed on the two sides; soon, however, the results of unequal growth become manifested in the disproportionate advance of some and the retrogression of others.

The vitelline veins in man, as may be anticipated from the relative insig-

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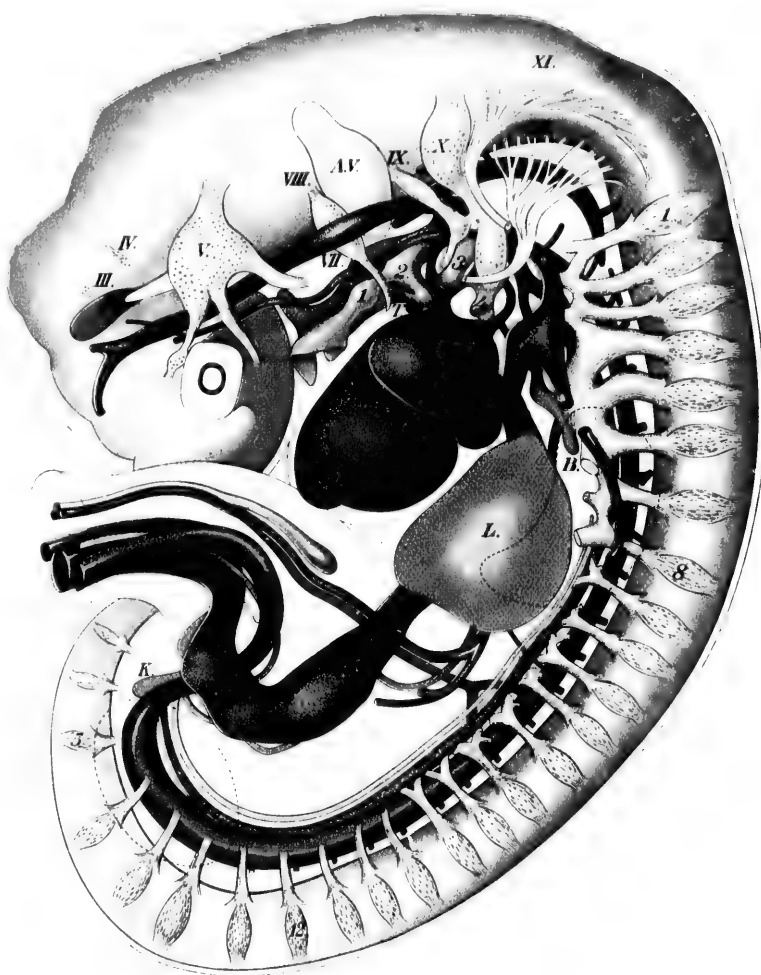
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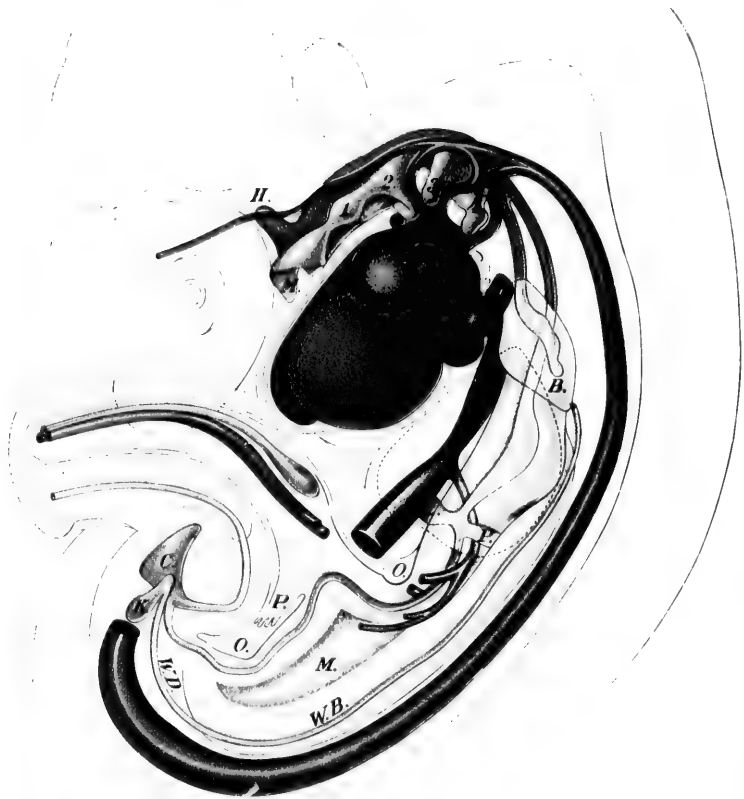
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Human embryo (reconstructed) of twenty-six days, viewed from the left side; magnified 25 diameters (after F. Mall); III. to XII., the cranial nerves; 1, 2, 3, and 4, respectively the first, second, third, and fourth pharyngeal pouches; A. 1., the auditory vesicle; B, bronchus; L, liver; K, kidney. The dotted lines indicate the extremities.



Human embryo, same as preceding figure, but taken at a deeper plane (after F. Mall); *H.*, diverticulum contributing the oral portion of the pituitary body; *M.* (above), primitive mouth; 1, 2, 3, 4, pharyngeal pouches; *B.*, bronchus; *P.*, pancreas; *L.*, liver; *W.B.*, Wolffian body; *W.D.*, Wolffian duct; *K.*, kidney; *C.*, cloaca; *O.*, openings by which pleuro-peritoneal cavities communicate; *P.*, papilliform projection into lower opening.

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nificance of the mammalian yolk-sac, never reach the development seen in lower types. After passing along the vitelline stalk and entering at the umbilical opening, the veins run in front and then at the sides of that part of the primitive gut-tract corresponding with the duodenum, and become closely associated with the liver (Fig. 99). The vitelline veins become connected by three newly formed transverse trunks, thus establishing two vascular rings which encircle the gut. The early direct communication above these rings with the

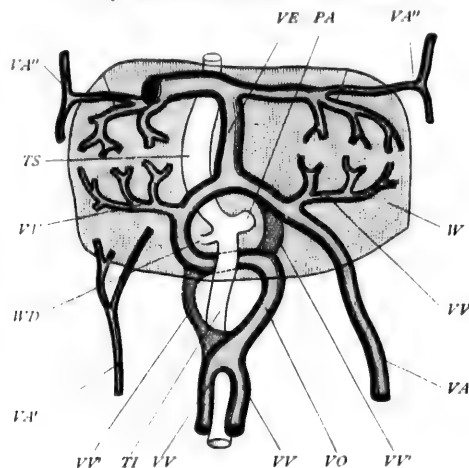


FIG. 99.—Development of the portal circulation of the human embryo of about three and a half weeks (Marshall, after His): PA, pancreas; TI, intestines; TS, stomach; WD, bile-duct; VA, left allantoic vein; VA', right allantoic vein; VA'', anterior detached portions of the allantoic veins; VE, ductus venosus; VO, portal vein; VV, vitelline vein; VV', portions of sinus annulares which disappear; W, liver.

sinus venosus becomes lost, and at the same time portions of the remaining parts of the vitelline veins become interrupted, while a new capillary system appears within the hepatic tissue, which has meanwhile surrounded the vessels, and provides communication between the veins themselves. Those portions of the vitelline vessels that pass from the upper venous ring to the capillary network are known as the *venæ advehentes*; they become the branches of the portal vein; those portions which pass from the capillary network to the sinus venosus, forming new relations, are the *venæ revehentes* and they become the *hepatic veins*. The vitelline veins at their lower communication become completely fused and receive veins from the intestinal tract, thus forming the main portal trunk.

The allantoic veins after the establishment of the placental circulation are known as the *umbilical veins*, of which for a time there are two. They fuse within the allantoic stalk, but remain as distinct vessels within the embryo, running within the lateral walls, for a much longer period. During the fourth week the connection of the allantoic veins with the sinus venosus is lost, and shortly afterward the right vein becomes much smaller than its fellow, and finally undergoes atrophy. The much larger left allantoic or

umbilical vein joins the primitive portal vein just as this vessel enters the hepatic tissue.

The early condition of the placental circulation for a time is such that all blood returning by the allantoic vein must traverse the capillary network of the liver in order to gain access to the heart, since both vitelline and allantoic veins have lost their direct communication with the sinus venosus. After a time, however, the liver is no longer capable of giving passage to the rapidly increasing volume of the placental circulation, and then a direct communication is established between the portal vein and the right hepatic vein. This new passage is the *ductus venosus*, by which the greater part of the blood is carried to the heart without traversing the hepatic substance.

The systemic veins arise partly from the primary venous trunks and partly as new vessels. The ducts of Cuvier receive the primitive jugular veins above and the cardinal veins below. The primitive jugulars later become the permanent external jugulars, the internal jugulars being formed as new trunks. The Cuvierian ducts, which undergo change of direction and lengthening, take a position almost vertical, becoming the *superior vena cava*, of which there are at first two. The development of the heart induces the disappearance of the greater part of the left superior cava, the proximal end, however, remaining as the insignificant coronary sinus which directly opens into the right auricle. With the atrophy of the left caval trunk a new transverse communication is necessitated to convey the blood from the left side to the remaining and enlarging superior cavæ. This need is supplied by the formation of the *transverse jugular*, which later becomes the greater part of the left innominate vein.

The fate of the once important posterior cardinal veins is linked with the history of the Wolffian bodies, whose venous outlet these veins largely are. With the atrophy of the Wolffian bodies the cardinal veins become less important, their final fate being partial disappearance and partial persistence as the azygos veins of adult anatomy.

The *inferior vena cava* presents a complicated development, for the details of which we are largely indebted to the recent investigations of Hochstetter. The inferior cava is developed partly as an independent trunk, and partly depends upon the appropriation of already existing veins. A new vessel is formed from the proximal end of the ductus venosus, from the point where that canal joins the hepatic veins, downward as far as the superior mesenteric artery, when it divides into two branches which join the primitive cardinals. This new vessel contributes the hepatic portion of the inferior vena cava. The further course of the latter vessel, as well as of the right common iliac vein, is provided for by the enlargement and extension of the lower part of the right primitive cardinal vein, that of the opposite disappearing. The external iliaes and the greater part of the left common iliac vein are new vessels.

7. Development of the Digestive Tract.—The formation of the digestive tube consists essentially in the folding off, closure, and isolation of that part

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of the yolk-sac immediately in contact with the axial portions of the entoderm. This differentiation is effected by the ventral extension and approximation of the widely expanded splanchnopleure, which, bending together (Fig. 100), gradually closes to form the primitive gut—at first freely opening into the yolk-sac, finally completely isolated from the latter except through the communication maintained by the narrow umbilical duct.

By the fifteenth day the gut has become defined to such extent that three parts are distinguishable—the fore-gut, the mid-gut, and the hind-gut. The *fore-gut*, which includes the cephalic third of the tube, gives rise to the pharynx, the esophagus, and the stomach, the latter organ early appearing as a fusiform enlargement of the primitive canal. The anterior end of the fore-gut reaches as far forward as the marked cephalic flexure opposite the mid-brain, and at first is separated from the primitive oral invagination, or *sto-*

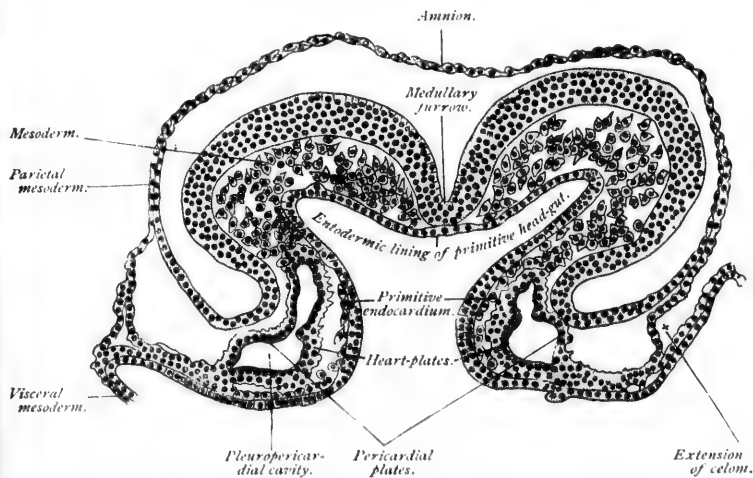


FIG. 100.—Transverse section of a sixteen and a half day sheep embryo (Bonnet).

matodeum (Fig. 101, A, B), by a septum consisting of the opposed ectodermic and entodermic layers. After the rupture of this partition, which happens during the fifteenth day, the primitive pharynx and oral cavity are directly continuous.

A series of four diverticula extend between the visceral arches, and constitute the *pharyngeal pouches* or *inner visceral furrows* (Fig. 106; Pl. 16). These evaginations of the pharyngeal lining are of interest, since the first pouch becomes converted into the Eustachian tube and the tympanic cavity, the third pouch into the early epithelial thymus body, and the fourth pouch into the lateral portions of the early thyroid body. From the ventral surface of the fore-gut, at the end of its pharyngeal division, there grows out the diverticulum, which gives rise to the respiratory tube and the epithelial parts of the pulmonary tissues.

The mid-gut, at first in free communication with the yolk-sac through the wide yolk-stalk, gradually becomes tubular and elongated, forming a narrow V-shaped loop whose straight and almost parallel limbs are attached behind to the dorsal wall of the body-cavity, above to the terminal part of the fore-gut at the stomach, and below to the hind-gut (Fig. 102). The apex of the loop receives the reduced yolk-stalk or umbilical duct, thereby becoming attached

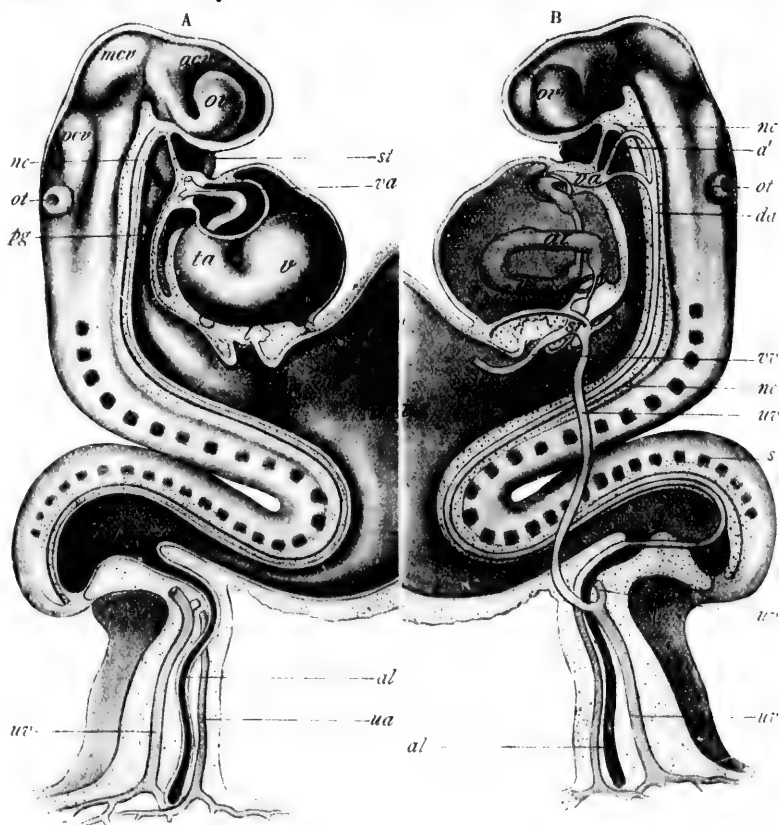


FIG. 101.—Reconstructions of human embryo of about fifteen days (H15): *acv*, *men*, *per*, anterior, middle, and posterior primary brain-vesicles; *or*, *ot*, optic and otic vesicles; *sl*, septum between primitive oral cavity and head-gut; *pg*, primitive gut; *v*, *ta*, ventricular and aortic segments of heart; *a'*, aortic arch; *va*, *da*, ventral and dorsal aorta; *l*, liver; *hg*, hind-gut; *nc*, notochord; *s*, somites; *uv*, sinus reunions; *uv'*, *ua*, umbilical veins and arteries; *al*, allantois.

to the ventral body-wall. The mid-gut gives rise to the entire small intestine and to the greater part of the large intestine. The liver and the pancreas are formed as diverticula and outgrowths from the lumen and the epithelial lining of the duodenal portion of the mid-gut.

The hind-gut soon loses its individuality and contributes the lower segment of the large intestine. In its primitive condition the hind-gut

includes that portion of the gut-tract lying behind the open mid-gut and terminating blindly in the sharply flexed caudal pole of the embryo; the greatly

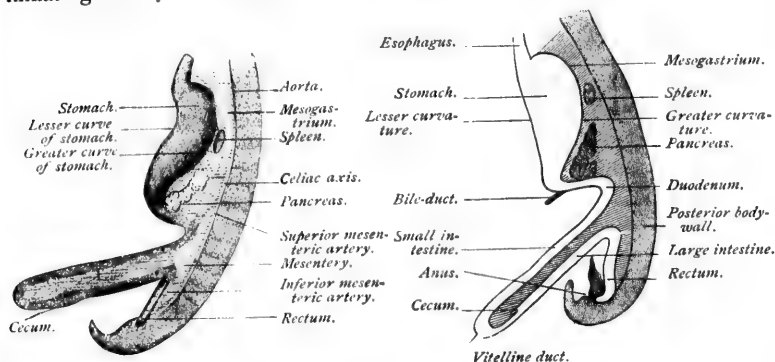


FIG. 102.—Intestinal canal of human embryo of six weeks (Toldt).

FIG. 103.—Digestive tract of human embryo of the sixth week (Toldt); arrangement of primitive visceral peritoneum.

dilated closed end of the tube constitutes the *cloaca*, the common receptacle for a time of the excretions of both the alimentary and the urinary tracts.

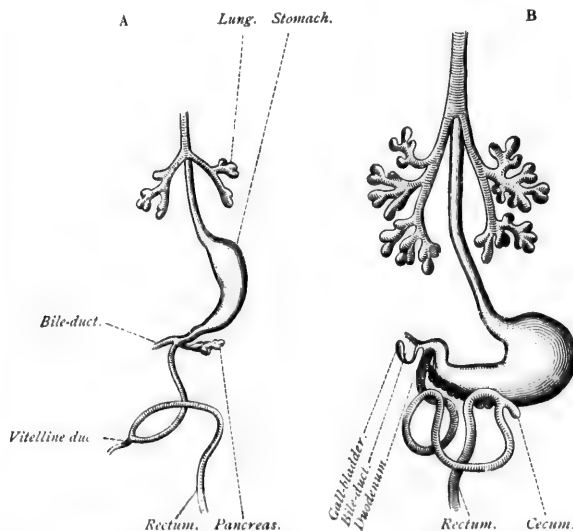


FIG. 104.—A, alimentary tract of human embryo of thirty-two days. B, alimentary tract of human embryo of thirty-five days (His).

The lumen of the allantoic sac, surrounded by the tissue of the allantoic stalk, extends from the ventral aspect of this space. At a later period communication with the exterior is established by the formation of the anal orifice. The external position of this opening is indicated by the *anal invagination* of the ectoderm or *proctoderm*.

During the early part of the fourth week the intestinal tube, composed of its several characteristic segments, lies in the sagittal plane attached to the dorsal wall of the body-cavity by the straight primitive mesentery (Fig. 103). A few days later a period of rapid growth is inaugurated, the intestinal tube increasing in length with far greater rapidity than the abdominal cavity expands. In consequence of this inequality in growth the small intestines become twisted and coiled, while the large gut takes up a position in front or ventrally, and above the turns of the smaller tube.

During the fifth week (Fig. 104) the esophagus elongates and the stomach acquires its characteristic form as well as an obliquely transverse position, its

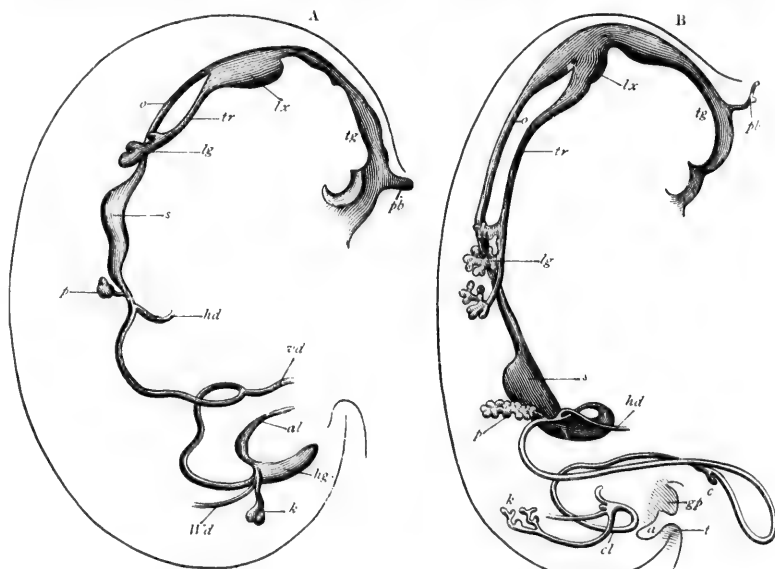


FIG. 105.—A, outline of alimentary canal of human embryo of twenty-eight days (His): *pb*, pituitary fossa; *tg*, tongue; *lx*, primitive larynx; *o*, esophagus; *tr*, trachea; *lg*, lung; *s*, stomach; *p*, pancreas; *hd*, hepatic duct; *vd*, vitelline duct; *al*, allantois; *hg*, hind-gut; *wd*, Wolffian duct; *k*, kidney. B, outline of alimentary canal of human embryo of thirty-five days (His): *pb*, pituitary fossa; *tg*, tongue; *lx*, primitive larynx; *o*, esophagus; *tr*, trachea; *lg*, lung; *s*, stomach; *p*, pancreas; *hd*, hepatic duct; *c*, cecum; *cl*, cloaca; *k*, kidney; *a*, anus; *gp*, genital eminence; *t*, caudal process.

former left side becoming directed anteriorly and upward, its former right side looking backward and downward. The cecum for a time is situated high up and in close relation with the transversely placed portion of the large intestine; later the blind end of this part of the gut descends, owing to the development of an intermediate portion which assumes the position and characteristics of the ascending colon. The cecum for a time is of uniform size; its further growth, however, is marked by the failure of the apical portion to keep pace with the increase in size of the remaining parts of the gut; in consequence, that portion which morphologically represents the end of the cecum remains as a narrow tubular attachment connected with the head of the large gut, this appendage constituting the *appendix vermiformis*—the oldest part of the cecum.

The connection of the yolk-stalk or vitelline duct (Fig. 105) with the intestinal canal rapidly becomes less conspicuous, and by the end of the fifth week the yolk-stalk has but slight connection with the gut. The position of the

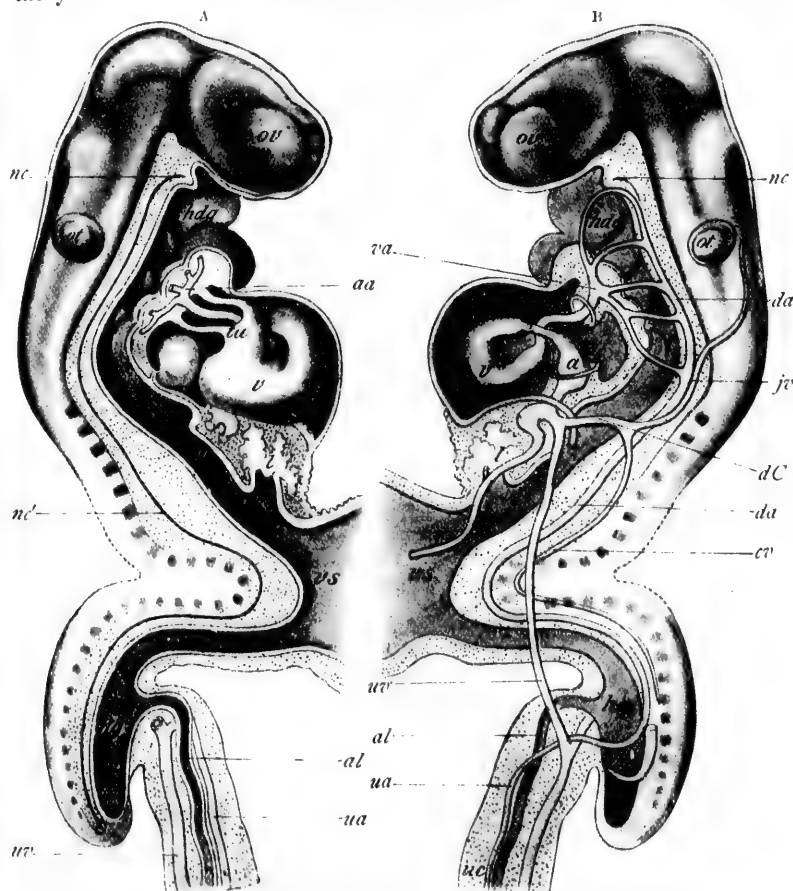


FIG. 106.—Reconstructions of human embryo of about seventeen days (His): *ov*, optic and *ot*, otic vesicles; *nc*, *nc'*, notochord; *hda*, head-gut; *g*, mid-gut; *hg*, hind-gut; *vs*, vitelline sac; *l*, liver; *v*, *ta*, primitive ventricle and truncus arteriosus; *va*, *da*, ventral and dorsal aorta; *aa*, aortic arches; *jr*, primitive jugular vein; *cr*, cardinal vein; *dc*, duct of Cuvier; *ur*, *ua*, umbilical vein and artery; *al*, allantois; *uc*, umbilical cord.

junction of the vitelline duct with the intestinal tract varies greatly, but usually corresponds with a point within the small intestine from 40 to 60 centimeters (16 to 24 inches) from the ilio-cecal valve. When the usually atrophic cord is replaced by a tubular recess, the persistent portion of the duct constitutes Meckel's diverticulum, a structure of interest. The vitelline duct may remain pervious throughout its intra-embryonal extent, resulting sometimes in congenital umbilical fistula. The ventrally situated intestinal loops for a time extend

through the umbilical opening into the allantoic stalk, in which, up to the twelfth week, they are normally present; after the third month, however, the coils are permanently withdrawn into the abdominal cavity.

The *liver* first appears about the fifteenth day as a diverticulum (Fig. 106) from the ventral wall of the fore-gut, surrounded at its end by a thick layer of cells. The organ is rapidly formed, the single diverticulum almost immediately dividing into two, which in turn send off secondary and tertiary sprout-like extensions of solid cell-masses. These cylindrical masses anastomose and form networks of cells throughout the mesodermic tissue assigned to the production of the liver. The spaces within the meshworks are occupied by the richly vascular mesodermic tissue which supplies the connective tissue and the contained blood-vessels and bile-ducts.

The *pancreas* (Fig. 105) and the *salivary glands* are developed as solid outgrowths from the epithelium of the digestive tract. The cylindrical cell-masses at first are slender, solid, and rather club-shaped at their free ends. They later acquire a lumen and expand into the characteristic compartments of a racemose gland.

8. Respiratory Tract.—The respiratory tract is closely related in its development with the digestive canal, since it is formed by a direct evagination from the ventral wall of the lower portion of the primitive pharynx. The primitive trachea grows downward for some distance parallel with the esophagus, and then divides into branches which correspond to the primary and secondary bronchi (Figs. 104, 105); subsequently each of these undergoes repeated dichotomous division, the resulting twigs in turn giving rise to smaller branches until the ultimate compartments of the pulmonary tissue are developed. The smaller primary bronchioles are solid cylinders at first, their lumina appearing later. The entodermic portion of the respiratory tract, directly derived from that of the primary digestive tube, forms the epithelial parts of the organs, the connective tissues and vascular constituents of the same being products of the mesodermic tracts into which extend the epithelial masses.

9. Development of the Genito-urinary Organs.—The early stages of the human embryo, as well as of other mammals, mark the appearance of the paired Wolffian bodies and the Wolffian ducts, which for a time represent a functioning excretory apparatus (Pl. 16), the ancestor of the permanent kidneys.

The *Wolffian duct* appears about the fifteenth day as a longitudinal cell-mass extending throughout the posterior half of the embryo. The duct is formed by the evagination and isolation of portions of the mesothelial lining of the body-cavity, the resulting cylindrical cell-mass forming a cord that extends at first to the surface ectoderm, with which it has temporarily close relations (Fig. 107). These appearances have given rise to the views advanced by several investigators, according to which the Wolffian duct is ectodermic in origin. Careful examinations of suitable preparations show that the relations of the developing Wolffian duct to the ectoderm are only secondary, and that the initial steps in the formation of the duct occur, as stated, as evaginations of

the mesothelium; the Wolffian duct therefore is a product of the mesoderm. After a time the blindly terminating distal ends of the ducts sink centrally and acquire a communication with the cloacal expansion of the hind-gut. At first the ducts are solid cylinders; subsequently they possess a lumen.

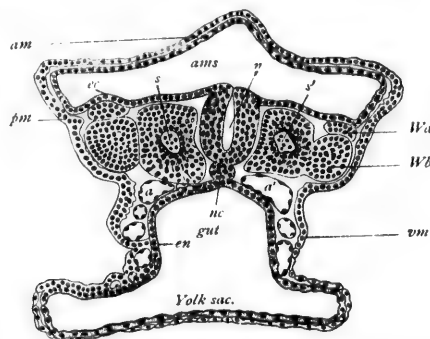


FIG. 107.—Transverse section of sixteen day sheep embryo (Bonnet): *ec*, ectoderm; *en*, entoderm; *pm*, parietal mesoderm; *vm*, visceral mesoderm; *am*, amnion; *ams*, amniotic sac; *s*, *s'*, somites; *a*, *a'*, aortæ; *nc*, notochord; *n*, neural canal; *Wd*, Wolffian duct; *Wb*, Wolffian body.

Some days later, usually about the eighteenth day, the *Wolffian bodies* appear as a series of short cylinders (Fig. 108) which form as buds from the mesothelium of the body-cavity entirely independently of the development of the Wolffian duct. These rods of cells at first are solid; during the fourth week they acquire lumina and become the Wolffian tubules, and later grow toward and join with the Wolffian ducts. The closed ends of the tubules

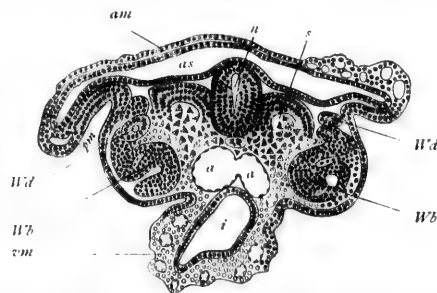


FIG. 108.—Transverse section of seventeen day sheep embryo (Bonnet): *am*, amnion; *as*, amniotic sac; *n*, neural canal; *s*, somite differentiated into muscle-plate; *Wd*, Wolffian duct; *Wb*, Wolffian body; *pm*, parietal mesoderm; *vm*, visceral mesoderm; *a*, *a'*, fusing primitive aortæ; *i*, intestine.

become expanded and then invaginated by the apposition of blood-vessels sent into the bodies from the aorta. The tufted blood-vessels and the invaginated tubule constitute the Malpighian bodies of the Wolffian bodies, the predecessors of the similar structures of the permanent kidney. All parts of the Wolffian bodies, therefore, are derived from the mesodermic tissues. Secondary tubules are formed as outgrowths from the primary ones whose origin has been sketched above.

The Wolffian bodies increase rapidly during the second month, gaining in size by the growth of the primary tubules and by the formation of new ones. These bodies act for a time as functioning excretory organs, the period of their greatest development being about the eighth week. After this time they undergo retrogressive change, so that by the fifth month the Malpighian bodies have largely disappeared and the entire organs become atrophic.

In view of important differences in growth, functional activity, and morphological significance of various parts of the Wolffian body, there are recog-

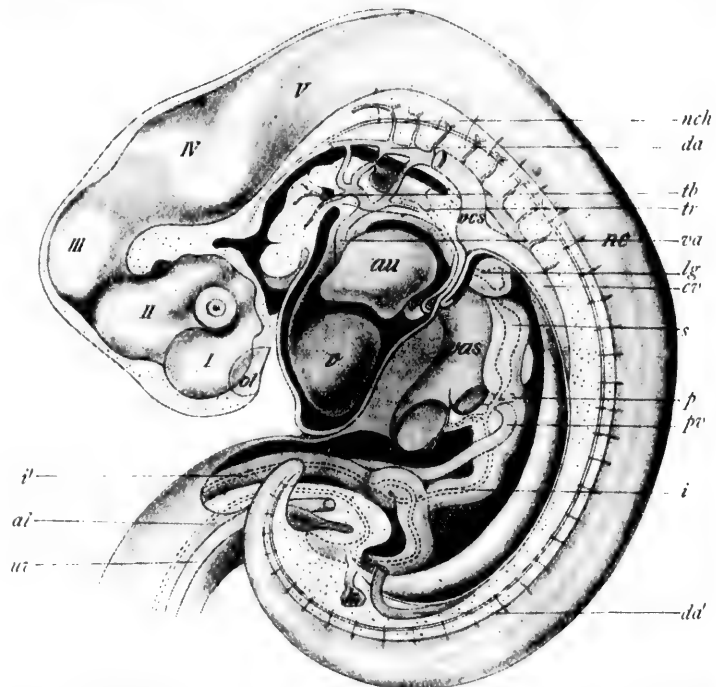


FIG. 109.—Reconstructed human embryo of about twenty-eight days (His): I-IV, brain-vesicles; nc, neural canal; nch, notochord; ol, olfactory pit; v, au, cardiac ventricle and auricle; va, da, ventral and dorsal aortae; da', termination of dorsal aorta; tb, median part of thyroid body; tr, larynx; lg, lung; s, stomach; p, pancreas; i, intestine; i', intesto-vitelline duct; al, allantoic duct; k, kidney; res, left superior vena cava; cv, cardinal vein; pr, portal vein; vas, vena ascendens, collecting blood from umbilical and portal veins; ur, umbilical vein.

nized an *anterior segment*, corresponding with the head-kidney of lower types, always backward in its development in mammals; a *middle segment*, which from its relation to the generative organs in their formation may be regarded as the sexual portion of the organ; and a *posterior segment*, likewise rudimentary in development and in the nature of the organs to which it contributes. The middle segment is of most importance both functionally and morphologically: this portion is sometimes designated the *mesonephros*.

The Müllerian Duct.—Coincidentally with the formation of the Wolffian

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duct, during the fourth week, an extended ridge of thickened mesothelium appears along the outer side of each Wolffian body, from which, however, this ridge is entirely independent. These ridges represent the early condition of the Müllerian ducts, the lumina appearing within the cell-cords about the fifth week. The Müllerian duct ends blindly below, and later possesses an expanded, trumpet-shaped anterior end. Its important morphological relations are considered in subsequent paragraphs.

The permanent excretory organ, the kidney, and its duct, the ureter, are derived primarily as outgrowths from the lower end of the Wolffian duct (Pl. 16, B; Figs. 105, 109). About the fourth week a diverticulum grows from the hinder end of the duct forward and dorsally into a mesodermic area close to and behind the lower end of the Wolffian body. The tube thus formed is the primitive ureter, which extends within the mesodermic tissue, where, after expanding into the immature pelvis, it breaks up into a number of tubes corresponding with the calices, from which pass epithelial cylinders representing the epithelial portions of the uriniferous tubules. Later the vascular mesoderm contributes the primitive glomeruli, which meet the expanded ends of the tubules and take part in the further development of the Malpighian bodies of the kidney. By the end of the second month the definite character of the renal structure has become established. As the permanent organ increases in size and functional importance the Wolffian body rapidly atrophies, so that by the end of the fourth month its activity as an excretory organ has disappeared, the parts still remaining bearing relations to the sexual apparatus alone.

The bladder is the persistent and expanded proximal portion of the allantoic duct which retains its lumen, while that of the distal segment of the same duct loses its lumen about the fifth week, becoming converted into a solid fibrous cord, the *urachus*, which stretches from the summit of the urinary bladder to the umbilicus. The bladder therefore differs from the kidney and the ureter in possessing a lining derived from the entoderm, and in not being entirely of mesodermic origin.

The formation of the internal generative organs consists of two distinct developmental processes, the development of the sexual glands and that of their excretory passages. At the end of the first month the mesothelial covering of the Wolffian bodies, along their inner borders, shows an extended area of thickening and proliferation, the resulting elevated bands, the *genital ridges*, being the earliest traces of the sexual glands. For a short time these glands are of an indifferent type (Fig. 110), the differential characteristics of the two sexes not being manifested, seemingly, for some days; the primitive male gland then exhibits a disposition to form networks of tortuous anastomosing cell-cords (Fig. 111), the forerunners of the seminiferous tubules; the female gland, on the contrary, possesses a larger number of the *primitive sexual cells*, and evinces a tendency of its elements to arrange themselves into groups in which the larger primitive ova become central figures. Microscopical examination of the sexual primitive glands even at the end of the fifth week is capable of distinguishing the future sex of the being. It is highly probable, as emphasized

by Nagel, that inherent sexual differences exist in the glands from their earliest appearance, and that the recognition of the indifferent stage depends largely upon our imperfect appreciation of these distinctions.

The development of the second part of the sexual apparatus, the system of excretory passages, depends upon the appropriation and modification of already existing tubes, the tubules of the Wolffian body, the Wolffian duct, and the

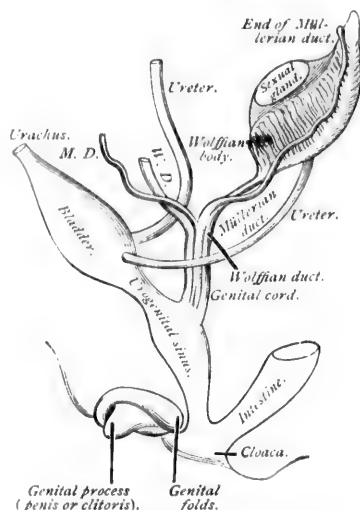


FIG. 110.—Diagram representing the indifferent stage in the development of the generative organs (modified from Allen Thompson).

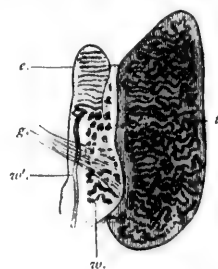


FIG. 111.—Internal generative organs of a male fetus of about fourteen weeks (Waldeyer): *t*, testicle; *e*, epididymis; *w'*, Wolffian duct; *w*, lower part of Wolffian body; *g*, gubernaculum testis.

Müllerian duct. The fate of these structures varies with sex. In the female (Fig. 112) the Müllerian ducts are most important; they develop into the ovi-

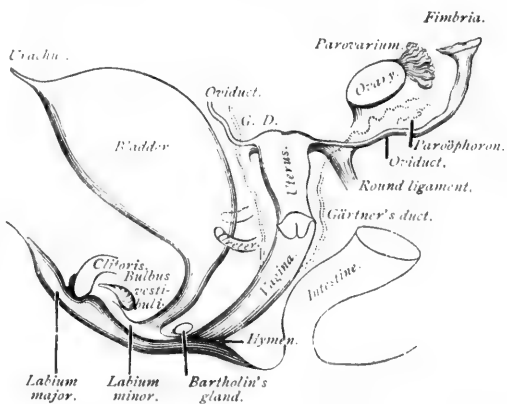


FIG. 112.—Diagram illustrating changes taking place in development of female generative organs (modified from Allen Thompson).

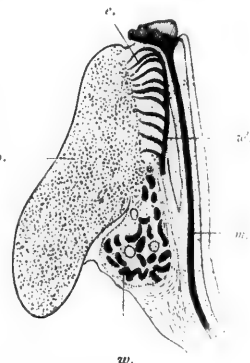


FIG. 113.—Internal organs of a female fetus of about fourteen weeks (Waldeyer): *o*, ovary; *e*, epoöphoron or paroöphoron; *w'*, Wolffian duct; *w*, Müllerian duct; *w*, lower part of the Wolffian body.

ducts, and, after becoming fused, into the uterus and the vagina, while the Wolffian bodies and duct give rise at best to atrophic structures. The Wolff-

ian body in the female contributes the *transverse tubules* of the parovarium or epoöphoron, the upper part of the Wolffian duct remaining as the *head-tube* of the same atrophic organ (Fig. 113). When the Wolffian duct persists it constitutes Gartner's duct. In the male subject (Fig. 114), on the contrary, the

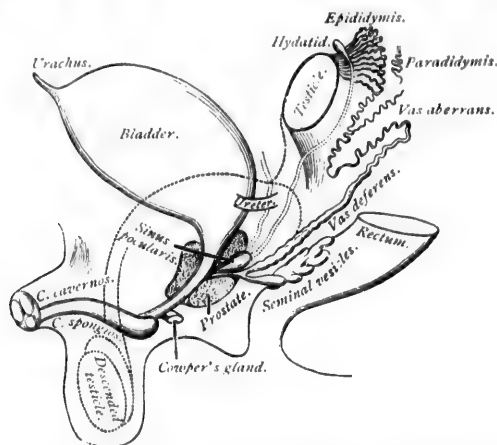


FIG. 114.—Diagram illustrating changes taking place in development of male generative organs (modified from Allen Thompson).

Wolffian tubules and the Wolffian duct contribute the important system of excretory tubes represented by the vasa efferentia, the coni vasculosi, the tube of the epididymis, and the vas deferens, while the Müllerian duct is atrophic, its extreme ends alone remaining as the sessile hydatid of Morgagni, closely connected with the globus major of the epididymis, and as the sinus popularis or *uterus masculinus*, opening into the prostatic portion of the urethra.

The atrophic tubules of the lower segment of the Wolffian body in both sexes contribute rudimentary organs, the *paradidymis* and the *paroöphoron* respectively, which consist of a few tortuous tubules situated in the epididymis and in the broad ligament near the parovarium. The stalked hydatids of Morgagni, which are common to both sexes, probably represent portions of the atrophic head-kidney and its duct.

The External Genital Organs.—Until the ninth or tenth week the external genitalia afford no positive information as to sex, since these parts until this time represent a practically indifferent type (Fig. 115).

Up to the sixth week the external openings of the gut and of the urinary tract are received within a common cloacal recess whose recto-urogenital orifice is surmounted by a small conical elevation, the *genital tubercle*; the lower and posterior surface of this eminence is divided by a furrow, the *genital groove*, bounded by thickened lips, the *genital folds*; outside the latter a less conspicuous elliptical fold constitutes the *genital ridges*. The end of the genital tubercle enlarges and forms a knob-like expansion, the primitive glans either of the future penis or of the clitoris. Toward the end of the second month

the imperfectly formed septum between the rectum and the urinogenital passage reaches perfection, whereby the complete separation between the alimentary and genito-urinary canals is effected.

In the male (Fig. 115, C, E, G) the genital tubercle elongates to form the penis, while the lips of the genital furrow on its under surface unite to form the

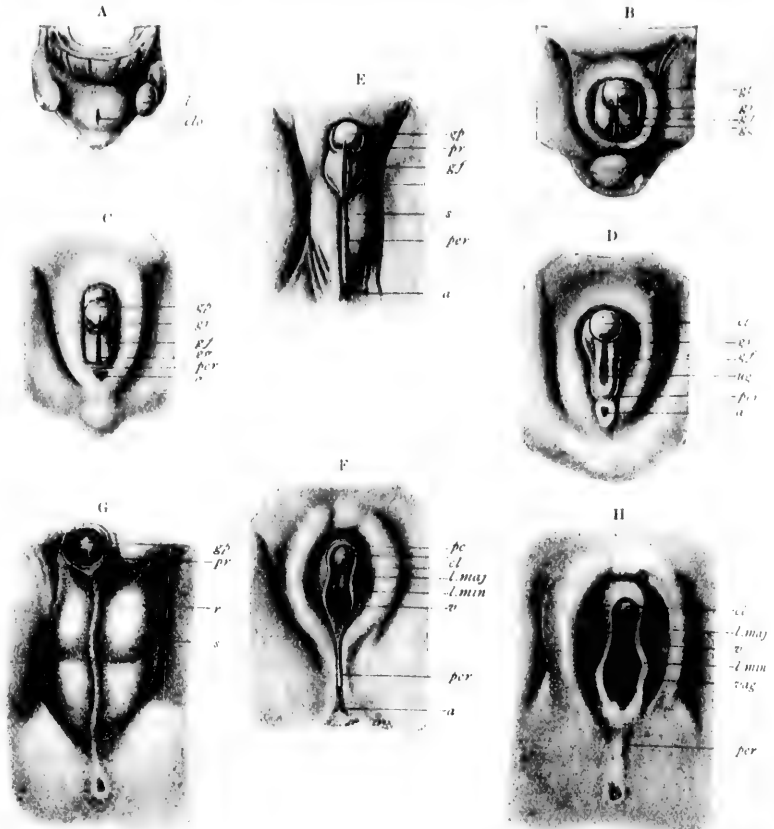


FIG. 115.—Development of external genital organs of human fetus (Ecker-Ziegler models): A, B, indifferent type, fifth to eighth week: *clo*, cloaca; *l*, lower limb; *gt*, genital tubercle; *gr*, genital ridge; *gf*, genital fold; *gg*, genital groove; *per*, perineum; *a*, anus; *pr*, prepuce; *s*, scrotum; *r*, raphe. D, F, H, organs of female type: *cl*, clitoris; *gr*, genital ridges; *gf*, genital folds; *ug*, urinogenital fissure; *per*, perineum; *a*, anus; *pc*, prepuce of clitoris; *l.maj*, labia majora; *l.min*, labia minora; *v*, vestibule; *vag*, vagina.

penile portion of the urethra; coincidentally, the closure of the edges of the urinogenital passage takes place, the tube thus formed becoming continuous with the anterior part of the urethra just formed. The primitive genital ridges or outer genital folds grow together and eventually form the scrotum, into which the testicles descend shortly before birth.

In the female (Fig. 115, D, F, H) the genital tubercle remains relatively small

and becomes the clitoris; the genital furrow remains open, the bounding genital folds forming the labia minora or the nymphæ, and the external folds forming the labia majora. At first the clitoris is disproportionately large, but later it becomes overshadowed by the rapidly growing labia. Usually, by the end of

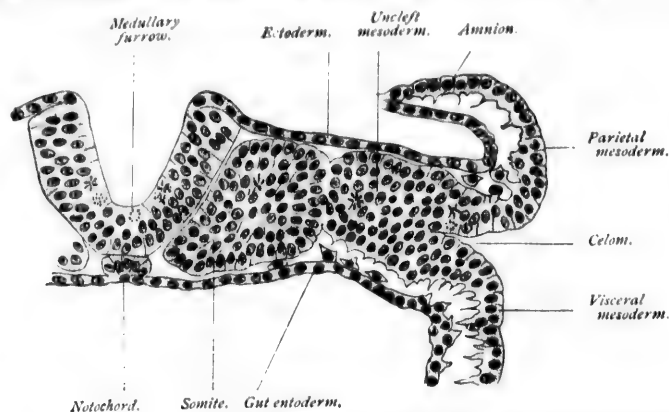


FIG. 116.—Transverse section of a sixteen and a half day sheep embryo possessing six somites (Bonnet).

the third month the external sexual characteristics of the fetus are established beyond doubt. Imperfect development, especially faulty union, of certain parts of the primitive genitalia produce the conditions which give rise to apparent hermaphroditism: true hermaphrodites, while not impossibilities, are

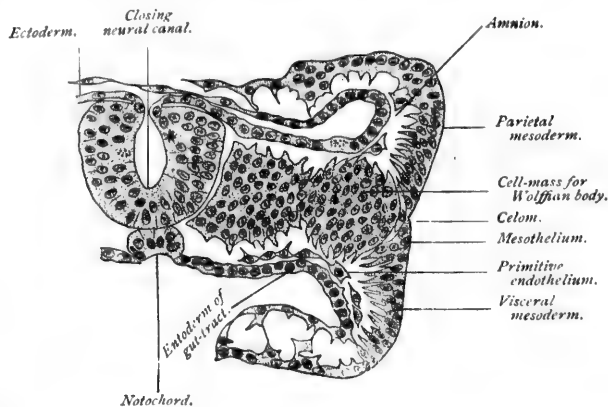


FIG. 117.—Transverse section of a fifteen and a half day sheep embryo possessing seven somites (Bonnet).

among the rarest malformations, since in them the formation of true sexual organs of both sexes must take place in the same individual.

10. **Development of the Nervous System.**—The initial stage in the production of the great cerebro-spinal nervous axis is the formation of the medullary folds and groove (Figs. 116, 117), one of the earliest of the fundamental

processes in the development of the embryo. At the thirteenth day the neural groove is widely open throughout its extent; two days later, by the beginning of the third week, the groove has become converted into a closed canal by the approximation of the thickened neural plates along the dorsal mid-line. The cephalic extremity of the neural canal,

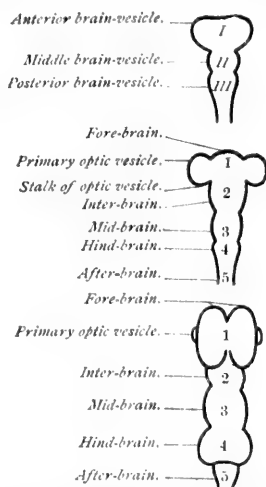


FIG. 118.—Diagrams illustrating the primary and secondary segmentation of the brain-tube (Bonnet).

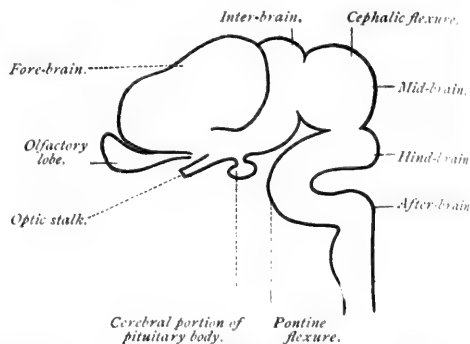


FIG. 119.—Diagram showing relations of brain-vesicles and flexures (Bonnet).

even before closure, becomes expanded into three *primary brain-vesicles*, the anterior, the middle, and the posterior. The anterior and the posterior of these vesicles very soon subdivide into *secondary* compartments, the arrangement of the brain-segments then being, from before backward, the *fore-brain*, the *inter-brain*, the *mid-brain*, the *hind-brain*, and the *after-brain* (Fig. 118).

Coincidentally with these changes the cerebral axis has suffered marked deflection (Fig. 119) from its original almost straight condition. By the fifteenth day the cranial flexure is strongly pronounced, a bend of almost 90° taking place opposite the mid-brain (Fig. 120, A). During the fourth week further marked changes appear; the bend opposite the mid-brain, or *mesencephalic flexure*, has increased almost to 180° , so that the ventral surfaces of the inter-brain and the hind-brain lie nearly in contact (Fig. 120, B). The junction of the brain and the spinal cord is marked by the *cervical flexure*, which forms an angle of about 90° . A third bend, the *metencephalic* or *frontal flexure*, appears opposite the primitive cerebellum and the pons, and has its convexity directed ventrally or in a manner opposite to the disposition of the other curves (Fig. 120, C).

The development of the individual parts of the brain depends largely upon local thickenings of parts of the walls of the cerebral vesicles, whereby areas of notable thickness are produced, as in those which give rise to the corpus striatum and the optic thalamus; the cleavage of the fore-brain and the ingrowth of connective-tissue structures accompanying the growth of the primitive falx likewise exert a profound influence in shaping the parts around

the lateral and third ventricles. The appearance of such commissural bands as the corpus callosum and the fornix still further modifies the adjacent struc-

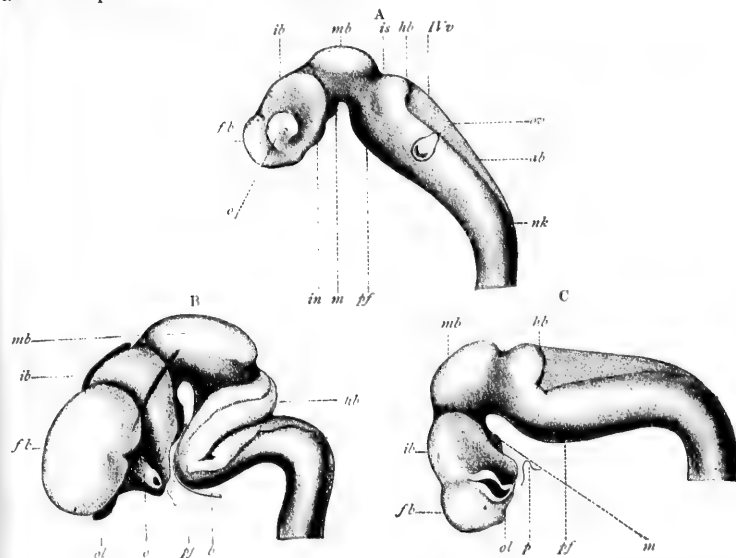


FIG. 120.—Brains of human embryos from reconstructions by His. A, brain from fifteen day embryo; B, from three and a half week embryo; C, from seven and a half week fetus; *fb*, *ib*, *mb*, *hb*, *ab*, fore-, inter-, mid- hind-, and after-brain vesicles; *o*, optic vesicle; *or*, otic vesicle; *in*, infundibulum; *m*, mammillary process; *pf*, pontine flexure; *IVv*, fourth ventricle; *pk*, cervical flexure; *ol*, olfactory lobe; *b*, basilar artery; *p*, pituitary recess.

tures. The brain-vesicle undergoing least change is the mid-brain, since its walls remain uncleft and retain their primary relations to the enclosed canal.

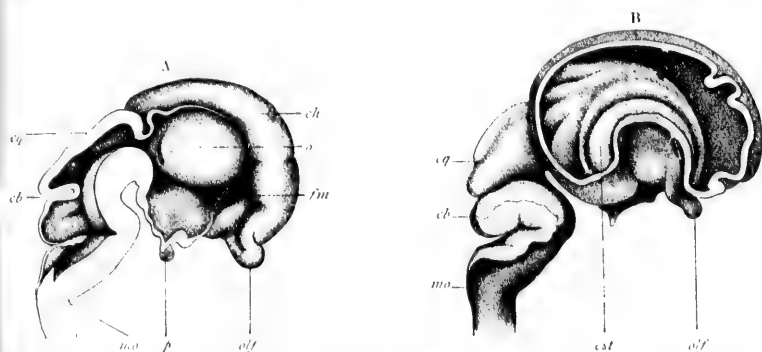


FIG. 121.—A, mesial section through brain of a human fetus of two and a half months (His): *ch*, cerebral hemisphere; *o*, optic thalamus; *fm*, foramen of Monro; *olf*, olfactory lobe; *p*, pituitary body; *mo*, medulla oblongata; *cq*, corpora quadrigemina; *cb*, cerebellum. B, brain of human fetus of three months (His): *olf*, olfactory lobe; *cat*, corpus striatum; *cq*, corpora quadrigemina; *cb*, cerebellum; *mo*, medulla oblongata.

The relative position of the mid-brain, however, undergoes great change, its original situation as the highest part of the entire encephalon being gradually

appropriated by the enormously developed cerebral mantle formed by the rapid-growing cerebral hemispheres; in consequence of the covering in of the mid-brain thus effected, the derivatives of this segment, as the corpora quadrigemina, occupy a position in the base of the adult brain instead of their morphologically normal place. The extent to which the cerebral mantle

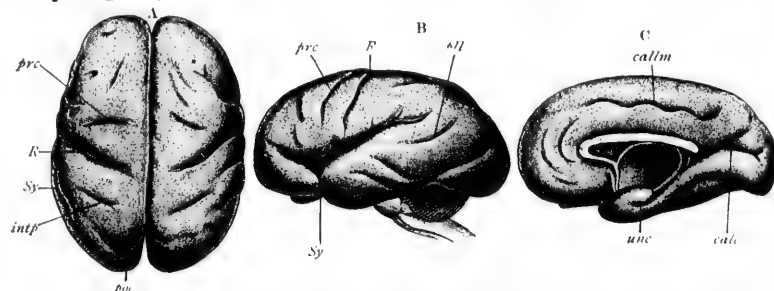


FIG. 122.—Fetal brain at the beginning of the eighth month (Mihalkovics): A, superior, B, lateral, C, mesial surface: *R*, fissure of Rolando; *pre*, precentral fissure; *Sy*, Sylvian fissure; *intp*, interparietal fissure; *poc*, parieto-occipital fissure; *pll*, parallel fissure; *calm*, callosal-marginal fissure; *unc*, uncus; *cal*, calcarine fissure.

covers the remaining parts of the encephalon, including the cerebellum, is distinctive of the human brain (Figs. 121, 122).

The inter-brain undergoes great differentiation, its derivatives forming numerous highly specialized organs, among which are the eyes and the pineal and pituitary bodies. For the complicated details of the development of the various parts of the brain the reader must be referred to the special works on embryology. The following table, however, modified from Hertwig, will serve as a general indication of the genetic relations existing between the more important parts of the encephalon and the primary cerebral segments:

DEVELOPMENT OF THE HUMAN BRAIN.

PRIMARY VESICLES.	SECONDARY VESICLES.	FLOOR.	ROOF.	SIDES.	CAVITY.	
I. Anterior primary brain-vesicle.	1. Fore-brain.	Anterior perforated spaces; olfactory lobes.	Great cerebral mantle; corpus callosum; fornx.		Lateral ventricles.	A. Brain-mantle.
	2. Inter-brain.	Optic chiasm; tuber cinereum; infundibulum; corpora mammill.	Pineal body; posterior commissure; velum interpositum.	Optic thalami.	Third ventricle.	
II. Middle primary brain-vesicle.	3. Mid-brain.	Cerebral peduncles; posterior perforated lamina.	Corpora quadrigemina.	Geniculate bodies; brachia.	Aqueduct of Sylvius.	B. Brain-stalk.
III. Posterior primary brain-vesicle.	4. Hind-brain.	Pons Varolii.	Anterior medullary velum; cerebellum; posterior medullary velum.	Superior and middle peduncles of cerebellum.		
	5. After-brain.	Medulla oblongata.	Thin covering of posterior part of fourth ventricle.	Inferior peduncles of cerebellum.	Fourth ventricle.	

The *spinal cord* is formed primarily by the thickening of the lateral wall of the neural tube, the latter becoming reduced to a narrow passage, later the central canal. At first gray matter alone exists, but with the formation of the nerve-fibres the white tracts appear (Fig. 123). The nerve-fibres connected

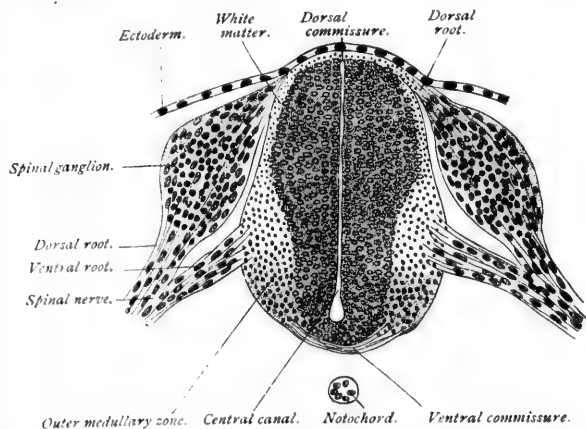


FIG. 123.—Transverse section of developing spinal cord of a twenty-two day sheep embryo (Bonnet).

with the spinal cord differ in origin according to their function whether they are motor or sensory, the former proceeding as outgrowths from the nerve-cells within the cord, the latter as processes from the cells of the spinal ganglia; these latter centres, in addition to the sensory fibres passing into the cord, send to the periphery fibres by which sensory impressions are conveyed. The *sympathetic nervous system* originates from the spinal ganglia, from which portions are separated as the organs of the sympathetic ganglia. It may therefore be accepted as an axiom that all nerve-fibres are produced as direct outgrowths from pre-existing nerve-cells, and, further, that all portions of the great nervous system may be referred to the primary neural folds.

11. Development of the Organs of Special Sense.—The history of the specialized organs of touch, taste, and smell, as represented by the various forms of tactile nerve-endings, such as the corpuscles of Meissner, Vater, etc., the taste-buds, and the Schneiderian mucous membrane, belongs to a consideration of the histogenesis of these structures rather than to a brief outline of salient features in general development; suffice it here to add that the organs of taste and smell consist essentially of tissue which has become specialized into neuro-epithelium, the perceptive elements consisting of modified epithelial cells bearing close relations to the nerve-fibres. The various forms of tactile corpuscles receive more or less highly developed sheaths from mesodermic tissues. The organs of sight and of hearing, on the contrary, claim greater attention on account of the profound embryological processes instituted in their formation.

The development of the *eye* consists essentially in the formation of two

ectodermic epithelial pouches, the optic vesicle and the lens-sac, around which the adjacent mesoderm differentiates into vascular and fibrous envelopes. The

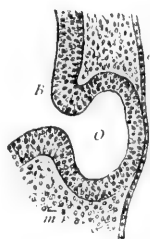


FIG. 124.—Section through head of ten day rabbit embryo, exhibiting primary optic vessel (*O*) protruding from fore-brain (*B*) and coming in contact with surface ectoderm (*e*); *m*, surrounding mesoderm (Piersol).

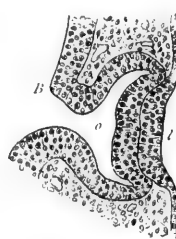


FIG. 125.—Section through developing eye of eleven day rabbit embryo (Piersol); *B*, fore-brain connected by stalk with optic vesicle (*o*), whose anterior wall is partly invaginated; *l*, thickened and depressed lens-area.

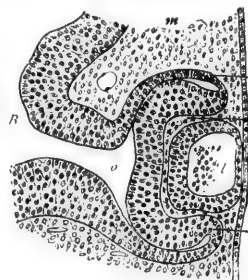


FIG. 126.—Section through developing eye of eleven and a half day rabbit embryo (Piersol); *B*, fore-brain connected with optic vesicle (*o*), nearly effaced by apposition of invaginated anterior segment (*r*) with posterior wall (*p*); *l*, lens-sac completely closed and separated from ectoderm; *t*, tissue within secondary optic cup derived from surrounding mesoderm.

first trace of the visual organs appears very early—at the fifteenth day—as the

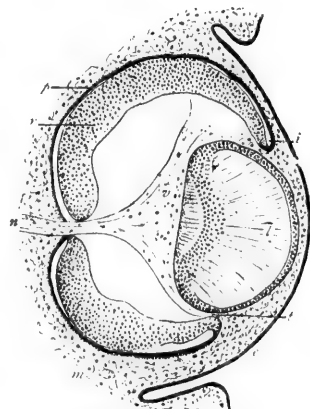


FIG. 127.—Section through developing eye of thirteen day rabbit embryo (Piersol); *e*, ectoderm; *l*, lens, consisting of anterior nucleated division representing thin front wall of lens-sac, and greatly thickened posterior division completely filling cavity of sac by elongated fibres whose nuclei present crescentic zone (*z*); *p*, posterior pigmented layer; *r*, specialized anterior retinal layer; *t*, point where layers of optic vessels become continuous; *n*, extreme peripheral section of tissue of primitive optic nerve connected with vascular tunic (*v*) occupying posterior surface of lens; *m*, surrounding mesoderm, which (at *t*) grows between lens and retina.

conspicuous optic vesicles (Fig. 128), which are formed as lateral evaginations from the hinder part of the anterior primary brain-vesicle; later, when the optic vesicle opens into the cerebral cavity by means of the optic stalk, the latter communicates with the inter-brain. The original optic vesicle soon exhibits indentation of its anterior wall (Fig. 125), the invagination progress-

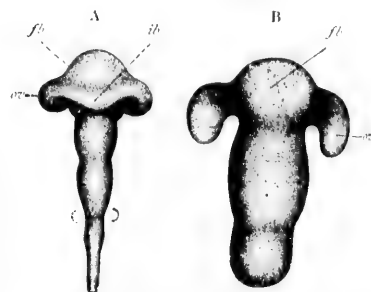


FIG. 128.—A, brain of two day chick embryo; B, brain of human embryo of three weeks. This shows the development of the optic vesicles and brain-vesicles: *fb*, fore-brain; *ib*, inter-brain; *ov*, optic vesicles.

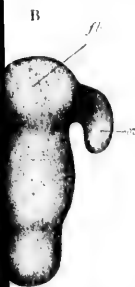
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undisturbed segment. The cavity of the original vesicle is now represented by the hemispherical cleft between the two layers. The cavity newly formed by the invagination of the primary vesicle becomes the *optic cup*, and represents the space later occupied by the crystalline lens and the vitreous body.

Coincidentally with the changes of the optic vesicle, the surface ectoderm at first exhibits a depression lined by thickened cells; this recess or pit rapidly

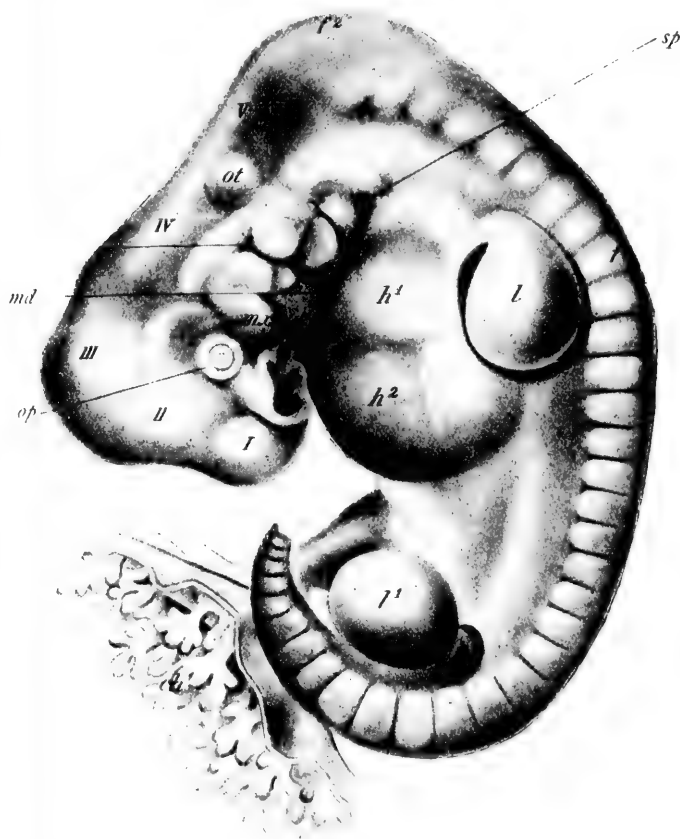


FIG. 129.—Human embryo of about twenty-eight days (Hls); *f*¹, *f*², *f*³, *f*⁴, cephalic, cervical, dorsal, and lumbar flexures; *op*, eye; *ot*, optic vesicle; *ol*, olfactory pit; *mx*, *md*, maxillary and mandibular processes of first visceral arch; *sp*, sinus precervicalls; *h*¹, *h*², heart; *l*, *p*, limbs; *al*, allantoic stalk; *ch*, villous chorion.

deepens and expands, and finally becomes the closed and isolated lens-sac, lying within the mouth of the optic cup, which it largely fills (Fig. 126).

The fate of the layers composing the optic cup, briefly stated, is the formation of the various parts of the retinal tract, the outer and posterior layer becoming the characteristic sheet of retinal pigment; the blood-vessels and the

connective-tissue elements of the retina are secondary ingrowths (Fig. 127). The hinder wall of the lens-sac undergoes great proliferation, growth, and thickening, and eventually fills the entire sac, the lens then continuing as a solid body composed of specialized epithelial elements.

The surrounding mesoderm contributes the blood-vessels, the vitreous body, the choroid, and the sclerotic coat, including the iris and the cornea with the exception of the anterior epithelium of the latter, which is ectodermic in origin. The eyelids, which appear toward the end of the second month, are developed as duplicatures of skin above and below the eye; about the end of the third or the beginning of the fourth month the lids meet and unite, the eyes remaining closed until near the end of gestation, when the lids permanently separate.

The *ear* includes several distinct developmental processes, since the genesis of the auditory apparatus of man includes the formation of the external, the middle, and the internal ear.

The *external ear* is closely related to the history of the first outer visceral furrow, the external canal being, with some minor variations, the representative of this cleft, and the expanded parts constituting its pinna, resulting from the fusion and metamorphosis of the *auditory tubercles* (Fig. 129) surrounding the outer end of the visceral furrow.

The *middle ear* is formed by the persistence and further expansion of the first pharyngeal pouch, hence possesses an entodermic lining. The tympanic membrane includes contributions from all three layers, its outer epithelium being ectodermic, its inner epithelium entodermic, and its fibrous tissue mesodermic, in origin.

The *internal ear* consists of the morphologically older ectodermic portion, which is represented by the complicated membranous labyrinth, and the surrounding mesodermic envelope, which becomes the bony capsule, and the connective-tissue structures included between the osseous and the membranous labyrinth.

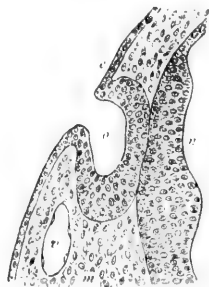


FIG. 130.—Section through developing ear of nine and a half day rabbit embryo (Piersol): *c*, ectoderm thickened and invaginated to form auditory pit (at *o*); *m*, surrounding still undifferentiated mesoderm; *n*, lining of neural tube; *v*, blood-vessel.

appears pyriform, that part corresponding with the closed mouth becoming extended; this elongation soon becomes more pronounced, so that the now some-

The earliest appearance of the ears takes place about the fifteenth day, when on each side of the hind-brain a depression lined by thickened ectoderm (Fig. 130), the *otic pit*, is formed. Almost immediately these pits become converted into sacs, the *otic vesicles*, by the closure of their mouths, and soon lose all connection with the ectoderm, lying entirely surrounded by mesodermic tissue some little distance beneath the free surface. The otic vesicle

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what flattened sac presents a conspicuous outgrowth, the *recessus labyrinthi* (Fig. 131, A).

The otic vesicle assumes greater irregularity on account of the appearance, during the fifth week, of a blunt diverticulum, anteriorly and ventrally directed, which is the earliest trace of the future membranous cochlea, and, shortly after, of dorsal projections on its outer side, which foreshadow the semicircular canals (Fig. 131, B, C). Before the end of the fifth month, the chief compartment of the vesicle, by this time of considerable size, undergoes

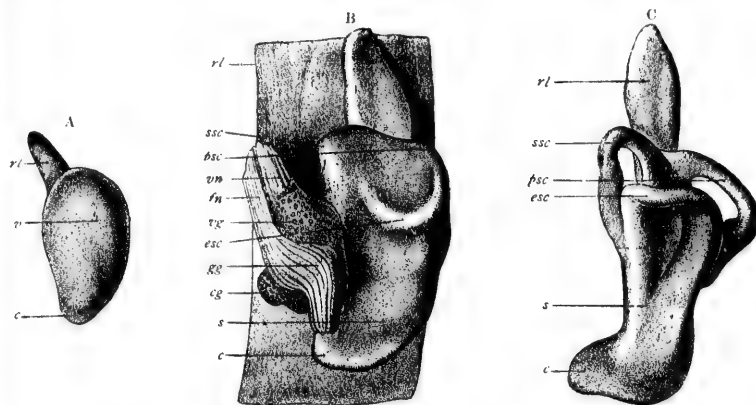


FIG. 131.—Development of the membranous labyrinth of the human ear (W. His, Jr.). A, left labyrinth of embryo of about four weeks, outer side: *v, c*, vestibular and cochlear portions; *rl*, recessus labyrinthi. B, left labyrinth with parts of facial and auditory nerves of embryo of about four and a half weeks: *rl*, recessus labyrinthi; *ssc, psc, esc*, superior, posterior, and external semicircular canals; *s*, sacculus; *c*, cochlea; *vn, fn*, vestibular and facial nerves; *vg, cg, gg*, vestibular, cochlear, and geniculate ganglia. C, left labyrinth of embryo of about five weeks, from without and below: labelling as in preceding figure.

subdivision by the formation of a constricting fold into a dorsal division, the primitive *utriculus*, and a ventral division, the primitive *sacculus*. The rudimentary semicircular canals and the primitive cochlear duct open respectively into the utricle and the sacculus. The recessus labyrinthi has become meanwhile greatly elongated, and its proximal end cleft into diverging tubes at the formation of a septum. These limbs of the recess open into different spaces, one entering into the sacculus, the other into the utricle.

The permanent arrangement is now established whereby communication between the divisions of the membranous vestibule, the utricle and the sacculus, is effected only by the indirect passage through the limbs of the ductus endolymphaticus. The primary otic vesicle thus becomes the complicated membranous labyrinth, and the ectodermic epithelial lining undergoes differentiation in the formation of the highly specialized structures, as the organ of Corti and the maculae acusticae, for the perception of transmitted stimuli.

The mesoderm immediately surrounding the membranous labyrinth later undergoes important changes, whereby the tissue next the epithelial structures is converted into the connective tissue enveloping and supporting the delicate

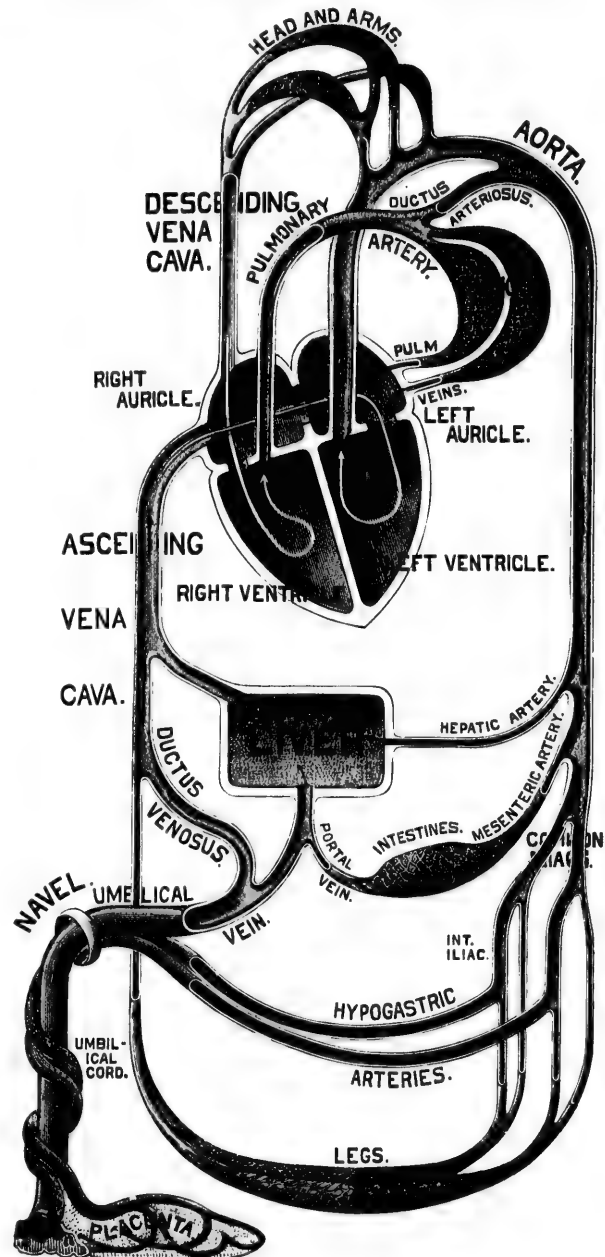


FIG. 132.—Diagram of fetal circulation before birth; the arrows indicate the course of the blood-current; the colors show the character of the blood carried by the different vessels.

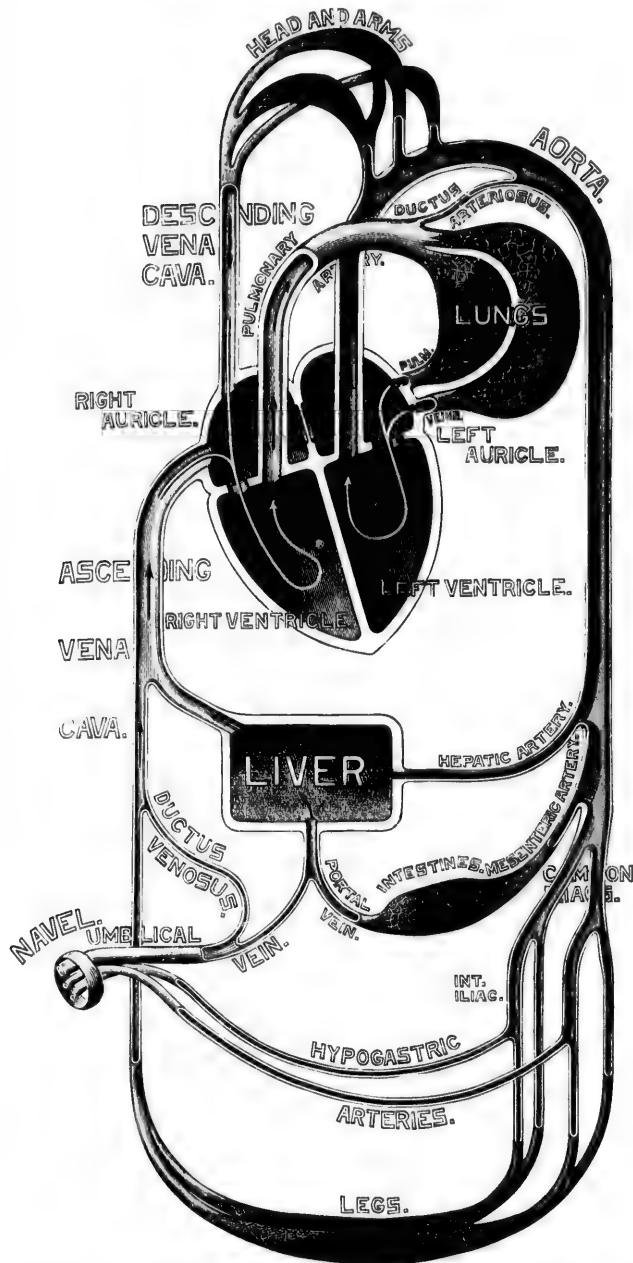


FIG. 133.—Diagram of circulation after birth; the ductus venosus, the foramen ovale, and the ductus arteriosus are now closed and no longer transmit portions of the blood-current.

epithelial labyrinth, while the tissue slightly removed gives rise to the periotic cartilaginous capsule which later is replaced by bone. The important spaces occupied by the perilymph are formed relatively late, since they arise by the breaking down and channelling of the mesoderm surrounding the epithelial tubes. In the cochlea, for example, the ductus cochlearis, with its epithelial lining, represents genetically the oldest part, while the scala vestibuli and the scala tympani are of more recent origin, since they are formed by partial disappearance of the mesodermic tissues.

2. PHYSIOLOGY OF THE FETUS.

Nutrition and Growth.—It is evident that the life of the ovum, whatever its character, whether vertebrate or invertebrate, picean, amphibian, reptilian, avian, or mammalian, can only be maintained when the fundamental necessities of life—adequate supplies of oxygen, water, and suitable nourishment—are provided. The ovum and the early embryo being without means of securing these advantages, such provisions must be ensured by the arrangement of the immediate environments, whether these be within the maternal tissues or within the protecting structures of the shell or the surrounding medium.

The loss of yolk, which there is good reason for believing the mammalian ovum has suffered during its evolution, is compensated by the nutritive materials supplied to the developing ovum by the adherent discus proligerus, and by the secretions of the oviduct and uterus which are taken into the interior of the egg by osmosis through the zona pellucida and the primitive chorion.

The Fetal Circulations.—The earliest circulation, the vitelline (Pl. 15), is well established during the third week. The blood passes from the network of the vascular area, by means of the large vitelline or *omphalo-mesenteric veins*, into the sinus venosus, and then, after mingling with the blood returned by the systemic veins from the body of the embryo, into the auricular segment of the young heart. From the anterior or arterial end of this organ the blood is carried by the *truncus arteriosus* into the aortic arches, hence into the primitive aortæ, a small portion passing into vessels supplying the embryo, while the greater part enters the vitelline arteries and once more gains the vascular area.

The development of the allantoic vessels and the placental circulation necessitates additional blood-currents, in the direction of which the now rapidly developing heart and liver exert an important influence. For a time all the blood returning from the placenta passes through the liver before reaching the heart; later, when the hepatic capillaries can no longer accommodate the entire placental circulation, the *ductus venosus* is established.

During the later months of gestation the so-called "fetal circulation" (Figs. 132, 133) presents the following details: After purification by the respiratory interchanges carried on within the placenta by association with the maternal circulation, the blood is conveyed by the single umbilical vein to the under surface of the liver; here the current divides, one part joining the venous blood within the portal vein collected from the intestines, and traversing the hepatic

capillaries to reach the hepatic veins, the other part passing into these vessels directly by means of the ductus venosus. On reaching the inferior cava the arterial placental blood, but slightly contaminated by admixture of the contents of the portal vein, is poured into the stream of venous blood returned by the inferior cava from the lower parts of the body, and is carried into the heart as part of the mixed stream. On entering the right auricle a fold, the Eustachian valve, directs the blood brought by the inferior cava across the auricular cavity through the foramen ovale into the left auricle. Mingling with the small quantity of blood returned from the uninflated lungs by the pulmonary veins, the blood-current passes through the auriculo-ventricular opening into the left ventricle, by the contractions of which it is propelled into the aorta, and distributed by the branches of that vessel to all parts of the body.

The blood gathered from the head and the upper extremities and returned to the right auricle by means of the superior cava passes directly through the auricle and right auriculo-ventricular orifice into the right ventricle, crossing in its course the blood-stream entering by the inferior cava. The contractions of the right ventricle send the blood thus returned by the superior cava into the pulmonary artery and on to the lungs. These organs, being still uninflated, are incapable of receiving more than a small part of the blood supplied from the ventricle; the excess, however, is carried by means of a newly-formed channel, the *ductus arteriosus*, which extends from the beginning of the left pulmonary artery to the aorta. The blood carried through this canal mingles with that descending the aorta; on reaching the hypogastric arteries a large part of the current passes to the placenta for oxygenation, only a small proportion of the stream continuing within the systemic arteries for the supply of the lower parts of the trunk and the inferior extremities. It will be noticed that after joining the current within the inferior vena cava the blood circulating within the fetus is nowhere purely arterial, but is always contaminated by the admixture of blood already distributed to other parts.

The distinctive features of the fetal circulation are the ductus venosus, the ductus arteriosus, the foramen ovale, the hypogastric arteries, and the umbilical vein. After birth, with the establishment of the respiratory function and the pulmonary circulation, the accessories to the arrangement of the placental blood-current undergo atrophy and largely disappear. While immediately instituted, these changes are not fully effected until some time after birth. Obliteration of the distal parts of the hypogastric arteries first occurs, and is usually completed by the third or the fourth day after birth. The ductus venosus and the umbilical vein are generally closed by the end of a week. The ductus arteriosus usually closes within a few days, and is completely impervious by the third week after birth. Permanent closure of the foramen ovale is delayed for some time, the blood being excluded from the left auricle by the apposition of the edges of the valve, which are kept in place by the increasing pressure from the left side exerted by the blood returning from the lungs. After a time the edges of the valve coalesce with the margin of the foramen ovale and the opening becomes permanently closed; not infrequently, how-

ever, months elapse before the union becomes complete. In case this union is never perfectly effected, a small communication may remain throughout life as a congenital defect, of slight or grave import depending upon the extent of the faulty union.

The establishment of the vitelline circulation, the first one of the embryo, marks the introduction of an important nutritive apparatus in animals possessing large yolks, which in them constitute sources of nourishment of great consequence. In man and other mammals, however, the appearance of the vitelline circulation must be regarded rather as the expression of formative processes whose usefulness has largely disappeared in consequence of the profound modifications which the diminution of yolk and the greater dependence on the maternal tissues have witnessed. While in mammals the exposure of the fetal blood-stream over the extended walls of the vitelline sac or umbilical vesicle affords an opportunity for a limited exchange of gases, the amount of nutritive materials directly taken up and appropriated by the embryo must be very insignificant.

The deficiencies of the vitelline circulation in mammals, however, are compensated by the active development of the allantoic vessels and their further specialization into the all-important placental circulation, whereby the respiratory and nutritive necessities are secured to the fetus throughout the last two-thirds of gestation.

The placental circulation, by means of which the respiratory interchange of gases and the passage of nutritive substances from the maternal blood to that of the fetus is effected, is undoubtedly the principal, and practically the sole, source of those substances necessary to maintain the life of the developing animal. The *liquor amnii* has long been regarded as an additional source of nutritive materials, in view of the fact that this fluid is undoubtedly swallowed by the embryo and taken into its intestinal canal, as shown by its presence, as well as the presence of hairs and epidermal cells at a later stage, within the gut. The composition of this fluid, however, renders it highly improbable that it contributes in any appreciable degree to the nourishment of the fetus, containing as it does nearly 99 per cent. of water. The *liquor amnii*, nevertheless, serves an important purpose in supplying the water necessary for the fetal tissues, since the latter must contain water in excess, according to Preyer, in order to extract the albumen and the salts from the blood brought by the umbilical vein.

The fetal placental vessels convey albumen, salts, and water from the maternal blood into the circulation of the fetus, as well as the oxygen absorbed by the red blood-cells during their sojourn in close proximity to the sinuses filled with the blood of the mother. The soluble salts probably pass from the maternal blood into the fetal blood by simple osmosis. That the albuminous substances, however, are so transferred is very doubtful, but the solution of this question, it must be admitted, so far has been unsatisfactory. The ingenious explanation advanced by Rauber, that a physiological transmigration of leucocytes from the maternal tissues into the fetus furnishes the means of

transportation of particles of albumin, fat, lecithin, and similar substances, lacks confirmation. By some the evidence is regarded as strong that they pass over in the form of soluble peptones.

That substances in solution pass from the maternal circulation into that of the fetus has been proved by direct experiments with iodine (Gusserow, Krukenberg, Haidlen), salicylic acid (Benicke), and potassium ferrocyanid (Fehling). The investigations of Zweifel demonstrated the free and rapid passage of chloroform administered during parturition from the maternal blood into the umbilical circulation, and, consequently, the highly probable influence of the anæsthetic upon the fetus. The result of attempts to introduce substances in a condition of fine division, but not in solution, such as vermilion, India ink, fat, etc., have been negative, the seeming exceptions where such particles were found in the fetal circulation after injection being attributable to injury of the blood-vessels.

The migration of formed elements, such as the pathogenic bacteria of anthrax, typhus, etc. or the colorless blood-corpuscles, from the circulation of the mother into the fetal blood is a question about which there is much difference of opinion. Regarding the blood-cells, moreover, the investigations of Sanger point to the improbability of such migration taking place, since in leukemic conditions of either mother or child the blood of the remaining organism may retain its normal proportions. The experiments of Savory and Gusserow have shown that in animals in which the fetus is poisoned by strychnia the poison may pass from the fetal circulation into that of the mother.

Certain substances administered to the mother pass into the liquor amnii, as in the case where iodine is given (Krukenberg). That the fetus takes no part in producing this effect is shown by the fact that the drug is found in the liquor amnii even when the product of conception is dead (Haidlen); further, that coloration of the amniotic fluid after the injection of sodium sulphindigotate into the jugular vein of the mother is unattended by the presence of the substance within either the kidneys or the urine of the fetus (Zuntz). The staining of the maternal tissues composing the decidua by the pigments contained within the meconium emphasizes the fact that substances within the liquor amnii may in turn affect the mother.

The respiratory and metabolic changes within the fetus are carried on by means of the oxygen taken up from the maternal circulation by the fetal blood-stream in its passage through the placenta, in exchange for the carbonic acid and other products of tissue-change. So long as this interchange of gases takes place without interruption in the placenta, the fetal circulation contains an excess of oxygen, since, notwithstanding the small amount derived from the mother, the quantity of this gas thus obtained more than suffices for the needs of the embryo, and induces a condition of apnea. When the placental circulation is interrupted, however, as by compression of the umbilical cord or by premature separation of the placenta, the fetus perishes with all the symptoms of asphyxiation.

The direct proof of the source of oxygen from the placenta has been supplied by the investigations of Cohnstein and Zuntz, who examined the blood of the umbilical vein in sheep, and found it richer in oxygen than that within the umbilical arteries, although the difference between the arterial and the venous blood during intra-uterine life is much less marked than after birth (Halliburton). The spectroscopic analysis of blood from the human umbilical vessels by Zweifel showed the presence of the oxyhemoglobin bands before respiration was established.

The consumption of oxygen by the fetus, as measured by the necessities of its own heat-production, is relatively small, since the maintenance of its temperature is greatly facilitated by being surrounded by the liquor amnii, the warmth of which is almost equal to that of the fetal blood. The fetus is still further favored by being spared the necessity of taking within its lungs and alimentary tract substances which must be warmed to its own temperature at the expense of its own heat. The presence of the warmed liquor amnii also prevents caloric loss by either radiation or evaporation.

The pre-natal functions of the fetus include limited activity of the kidneys and preparatory exercise of the organs and glands connected with the alimentary tract and the integument.

The early excretory apparatus of the embryo is represented by the Wolffian bodies and their ducts and the allantois. The yellowish fluid collected within the allantoic sac after its secretion by the Wolffian bodies cannot be regarded as urine in the strict sense of the term, since its elaboration long precedes the development of the fetal kidneys. There is, however, a similarity between the usually alkaline allantoic fluid and the later secretion of the fetal kidneys, the fluid often, but not invariably, containing urea, uric acid, the alkaline chlorids, phosphates, and sulphates, as well as iron, calcium carbonate, and allantoid. The early presence of urea and the urates renders it highly probable that the decomposition of albumin with oxidation begins at an early period of intra-uterine life, the excreted substances being taken from the still imperfectly differentiated fetal blood.

The question whether the kidneys under normal conditions regularly secrete urine before birth has received much attention and various answers. The weight of evidence undoubtedly establishes the exercise of such function, but exactly the period at which the secretion of urine first takes place is still undetermined. After the establishment of communication between the bladder and the exterior of the body by the formation of the urethral canal, the urine is discharged, during the later weeks of gestation, into the amniotic fluid, with which it is in part swallowed by the fetus. The coloring matters of the urine are elaborated only in very limited quantities, as shown by the well-known pale tint of the fluid voided by the new-born child.

Digestive Tract.—The pre-natal activity of the glands connected with the fetal alimentary tract is a matter of much interest in view of the demands made upon these organs immediately after birth to supply the ferments necessary in the process of digestion and assimilation. The inherent difficulties

attending the investigation of the subject in the human fetus have left our knowledge on many points still far from satisfactory.

The saliva of the fetus has received much attention with a view of determining the presence or absence of ptyalin. While the results of the observations by various investigators are contradictory, the positive evidence of the presence of this ferment in the saliva of the new-born obtained by Schiffer is important. This observer demonstrated the unmistakable presence of ptyalin in the salivary secretion of three new-born children, thus showing that the capability of converting starch into sugar exists in the saliva from birth—a fact the more remarkable when the absence of the opportunity for the exercise of this power is recalled, the character of the early food requiring neither starch nor dextrin. It has been shown that the ptyalin is not elaborated independently by the salivary glands, but that its presence is limited to the secretion and tissue of the parotid. The relatively tardy development of the labial and other glands of the oral cavity is in accord with the observed slight activity of the secretory function of the mouth of the fetus.

The gastric secretions of the new-born have been found to contain pepsin and rennin immediately after birth, pepsin digestion and the power of curdling milk being established within a few hours. The observed differences in the amount of pepsin contained in specimens of the mucous membrane of new-born children probably depend upon the variability in the development of the gastric glands, as pointed out by Sewall.

The pancreatic ferments are probably represented before birth by the presence of *trypsin*, which acts especially upon the proteids, and a fat-splitting ferment (*pancreatin*, *steapsin*), but not by *amyllopsin*, which resembles ptyalin in possessing the power of attacking starch. Langendorff demonstrated the presence of trypsin in the pancreas of the fetus at the fifth and sixth month; Zweifel, that of pancreatin at birth. The large amount of fatty and albuminous matters in the milk at once suggests the necessity of the early preparation of the digestive ferments required for the disposition of these substances.

The intestinal secretions at birth differ widely from those of a slightly later period. In this respect the observation of Werber, showing the relatively larger number of Brunner's glands in the new-born than during later life, is of interest, although the function of the glands within the fetus is not obvious.

The liver early develops, and soon becomes the most conspicuous organ connected with the fetal digestive apparatus. Its large size suggests an early activity, which, in fact, observations on mammalian embryos confirm. A substance resembling bile has been found in the small intestines from the third to the fifth month, and later in the large gut; in this material, from fetuses of the third month, Zweifel found the bile-acids and the biliary pigments.

The meconium, the contents of the fetal intestinal canal at birth, presents a dark, brownish-green or almost black appearance, and a soft, viscid, pitch-like consistence. Its source has been the subject of interesting investigation, but much relating to its origin still remains to be investigated. The production of meconium seems chiefly related to the formation of bile, since it is

absent before this secretion is poured into the intestinal canal, as well as in cases of malformation in which the elaboration of bile is wanting. The view attributing to the swallowed liquor amnii an active rôle in the formation of the meconium is opposed by the presence of this substance in malformed fetuses in which the possibility of entrance of the amniotic fluid into the intestines was precluded.

Before the secretion of bile meconium is not present. Hennig observed light yellowish-green meconium in a fetus at the beginning of the fourth month. The beginning of the fifth month usually marks the period from which the meconium is constantly present. This substance, in addition to the bile, consists of the unabsorbed portions of the intestinal mucus and juices, the secretions of the glands of Brunner and of the pancreas, and of the swallowed amniotic liquid, together with such remains as leucocytes, intestinal epithelium, lanugo, epidermal cells, and fat from the vernix caseosa carried into the gut-tract along with the liquor amnii.

The chemical composition of meconium, as ascertained by Zweifel, includes from 20 to 27 per cent. of solids, of which about 1 per cent. is inorganic, the remainder organic; the amount of fat and fat-acids and of cholesterin is the same—about .75 per cent. The inorganic constituents include the phosphates and sulphates of magnesium and calcium, sodium chlorid, and oxid of iron. The principal organic substances are the more or less changed bile-salts, the unaltered bile-pigments, bilirubin and biliverdin, and mucin.

3. MULTIPLE CONCEPTIONS.

The fecundation of more than a single ovum, or, as often less accurately termed, "multiple pregnancy," is by no means an infrequent occurrence, as the numerous births of two or more children testify. Multiple conceptions may result in the birth of twins, triplets, and, as great rarities, quadruplets; a number of well-authenticated instances of five children at one time are recorded; and even an apparently trustworthy case of the birth of six, four boys and two girls, has been reported by Vassalli. The reputed births in excess of this number are apocryphal.

The most extensive series examined with a view of determining the relative frequency of multiple conceptions is that studied by G. Veit, which included the records of thirteen million births in Prussia. According to these statistics, twins occur once in 88 births; triplets, once in 7910; and quadruplets, once in 371,126. About a dozen authentic cases of five at a birth are recorded in medical literature (Kaltenbach). The statistics of different countries seemingly point to considerable variations in the frequency of twins, thus, in Bohemia twins occur once in about 60 births, while in France they appear only once in every 100. Recent statistics supplied by the Board of Health of New York and of Philadelphia place the frequency of twin births in these cities at 1 in every 120 births. In accepting such conclusions, however, possible errors arising from differences in the character and completeness of the statistics compared must not be overlooked.

Of 150,000 twin pregnancies studied by Veit, in one-third both children were boys; in slightly less than one-third both were girls; and in the remaining third both sexes were represented. Twins are more frequent in multiparae than in primiparae. Individual and inherited tendencies seem also to be factors in the occurrence of multiple conceptions, since plural births sometimes render particular women or certain families conspicuous.

Twins usually develop from two distinct ova derived from the same or from different Graafian vesicles, which may be separated widely or which may even be contributed by different ovaries, as shown by the presence and location of the corpora lutea. When derived from a single ovum, the existence of a double germ may be assumed, with, however, the possibility borne in mind that the twins may have arisen as the result of complete fusion of a single germ, as emphasized by Ahlfeld in his investigation of the production of double monsters. Twins originating in this manner are termed "homologous" and are characterized by remarkable physical and mental similarity. Of 506 cases of twins, Ahlfeld found but sixty-six proceeding from a single egg. Twins derived from a single ovum are always of the same sex; those from two ova may be of different or of the same sex.

The arrangement of the fetal membranes of twins depends upon the mode of their origin. The decidua vera is always simple; the decidua reflexa, on the contrary, is double when the ova become attached to widely separated parts of the uterine wall. The chorion, being primarily derived from the zona pellucida, is single when the twins originate from two germs contained within a single ovum, but double when they arise from separate eggs. The amnion is primarily always single, since this membrane is produced as an outgrowth and extension of the embryo itself. In those cases where twins occupy a common amniotic sac, a secondary fusion of the two originally distinct sacs has occurred by the breaking down and absorption of the septum which for a time separated them.

The placenta is at first double, since each fetus forms its own allantois and resulting placental area. When the twins originate from different ova the placenta may remain permanently distinct, but even in such cases fusion of the placental areas eventually takes place. The placental vessels of single-egged twins almost invariably anastomose, so that the placentae become more or less completely fused, the common nutritive area then consisting of three parts, an intermediate, indifferent area being enjoyed in common, in addition to the particular part which ministers especially to each fetus (Hyrtl). The anastomosis of the placental vessels may result in the most profound impressions in those cases where marked differences exist in the development and vigor of the two fetuses, since the circulation of the weaker fetus may be unfavorably influenced, even to the extent of reversal (Ahlfeld), by the overpowering force of that of its stronger brother. Disastrous atrophy and the production of an *acardia* are among the results attributable to such conditions.

When one fetus succumbs, the pressure exerted during the growth of the living child gradually reduces the mass of the dead product of conception, until

finally it is represented by the greatly flattened and attenuated remains imprisoned against the uterine walls, then constituting the "fetus papyraceus" of the teratologist. Conspicuous, and sometimes remarkable, disparity in the perfection of growth and development may exist in twins at birth, the more favored fetus sometimes exceeding the smaller threefold in weight, the difference depending upon the nutritive advantages enjoyed by the one at the expense of its less fortunate fellow. In consequence of this disparity it sometimes, though very rarely, happens that the fully-matured fetus is expelled at term, while the still imperfectly developed fetus is retained for a time within the uterus until its development has progressed farther toward completion, when it in turn is born. Two remarkable cases in which double uteri were present have been recorded by Barker and Generali, where intervals of forty-three and thirty days respectively intervened between the births of the two fetuses. It is the occurrence of such cases which is erroneously regarded as a fact in support of the possibility of superfetation.

Triplets may originate, it is evident, from a single ovum or from two or three distinct eggs, a frequent arrangement being that one child is derived from a distinct ovum and two from a single ovum. Upon the manner of their origin depend the arrangement and relations of the placenta and membranes. Quadruplets may exist as double twins, or they may result from a combination of a single birth with triplets.

Plural conceptions, on the one hand, may result from a single coitus, whereby are impregnated ova which have simultaneously been discharged from the sexual gland, prepared for the reception of the male elements; on the other hand, repeated impregnations may occur after different, though closely following, sexual acts, these resulting in the fecundation of different ova which have been liberated at slightly separated moments, but which belong to the same ovulation. This possibility has received recognition in the term *superfecundation* or *superimpregnation*, by which is understood the fecundation of two ova, belonging to the same period, by different sexual acts. Conspicuous examples of such occurrences are afforded by instances where a negress gives birth to a white and a black child.

While the occurrence of superimpregnation is undisputed, *superfetation*, or the possibility of ova which originate from different ovulation periods, and therefore liberated at considerable intervals, being impregnated by sexual acts widely separated, is not admissible. While instances of the delayed birth of a second child are adduced in support of the recognition of the possibility of superfetation, the obvious physical impossibilities of the assumed occurrence are unanswerable objections to the validity of such interpretation. When the rapid and important changes in both the ovum and its environment that follow fecundation are recalled, the impossibility of spermatozoa reaching and impregnating an additional ovum on the one hand, and of the ovum, even although fecundated, descending the Fallopian tube to the uterus, on the other hand, is manifest. The cases cited in support of superfetation are all explicable from the well-known facts attending the unequal growth and devel-

opment of twin conceptions, where this disparity results in the delayed delivery of the less favored fetus.

Plural births frequently occur before term, twins being born a few weeks before the end of gestation, quadruplets and quintuplets in the earlier months of pregnancy.

4. CHANGES IN THE MATERNAL ORGANISM INDUCED BY PREGNANCY.

1. *Local Changes.*—The presence of the fecundated ovum inaugurates a season of increased nutritive energy, which not only effects changes in those organs in immediate relations with the developing fetus, but also induces changes involving the entire organism of the mother during the continuance of pregnancy. The changes thus induced in the general system being discussed in a separate section (p. 153), consideration in the present place will be directed to those changes manifested by the sexual organs and the parts intimately connected with the processes of gestation and parturition.

The uterus, as may be expected from its especial relation to the developing fetus, early manifests the profound changes which it undergoes; indeed, the preparatory alterations affecting its mucous lining and vascularity preceding each menstrual epoch must be regarded as the beginning of the cycle of changes that ends only with the return of the organ to its normal condition after the expulsion of the product of conception and the protecting structures.

The hypertrophy of the mucous membrane of the uterus and the greatly increased vascular supply which take place coincidently with the liberation of the ripe ovum from the ovary, under usual conditions, are succeeded by the destructive changes giving rise to the phenomena of menstruation. Should impregnation, on the contrary, occur, the hypertrophic processes are continued with increased vigor, and result in the alterations already described in connection with the formation of the decidua (p. 86).

The most conspicuous consequence of the changes in the uterus is the notable increase in the size and weight of this organ. From the insignificant dimensions of the small, rigid virgin uterus, which include a length of 7 centimeters ($2\frac{3}{4}$ inches), a breadth of 4.5 centimeters ($1\frac{3}{4}$ inches), and a thickness of 2.5 centimeters (1 inch), there is developed a huge flaccid sac which measures at the close of gestation from 37 to 38 centimeters ($15\frac{1}{4}$ inches) in length, 26 centimeters ($10\frac{3}{8}$ inches) in breadth, and 24.4 centimeters ($9\frac{3}{8}$ inches) in thickness, with a circumference at the level of the oviducts of from 70 to 73 centimeters (29 inches).

The weight of the virgin uterus is about 40 grams ($1\frac{1}{4}$ ounces); that of the uterus at term, about 1000 grams (2 pounds), an increase of twenty-five times taking place. The capacity of the uterus at the close of gestation is between 4000 and 5000 cubic centimeters (from 8 to 10 pints), or over five hundred times that of the virgin organ.

The increase in the bulk of the uterus occurring during the earliest months of pregnancy is attributable to the general hypertrophy affecting its walls, and not directly to the developing ovum, since only after the latter completely fills

the uterine cavity, at the expiration of the fifth month, is the augmented size of the uterus produced by the mechanical distention caused by the rapidly growing fetus. The enlargement of the uterus, moreover, is not directly dependent upon the presence of the ovum, but is due to actual increase of tissue, as shown by the fact that the hypertrophy of the organ progresses up to the fourth month in extra-uterine pregnancies, the same as if the ovum were present within the uterine cavity.

The hypertrophy of the uterus at first affects equally all parts of the viscus, but later the fundus and the body grow more rapidly than the cervix. The changes which affect the uterine walls consist of thickening of the mucous membrane, increase of the muscular tissue, augmentation of the connective tissue, and enlargement of the blood-vessels, the lymphatics, and the nerves. As a result of these alterations the walls for a time reach a thickness of 1.5 centimeters ($\frac{3}{8}$ inch); but this excessive growth is followed by a marked reduction resulting from the distention incident to the later months of pregnancy, when the extended uterine walls measure but 5 millimeters ($\frac{3}{16}$ inch) in thickness.

The increase of the muscular tunic is effected not only by excessive growth of the already existing involuntary muscle-fibres, which increase from ten to eleven times in length and from three to five times in breadth, but also by the formation of new muscular elements which likewise soon acquire the dimensions of .5 millimeter in length by .02 millimeter in breadth.

The lumina of the uterine blood-vessels are materially increased, the arteries becoming wider and longer—without, however, entirely losing their tortuosity—and the veins dilating into large venous channels, the *sinus uterini*, which penetrate between the muscular fasciculi and which are particularly well developed within the placental area. The walls of the venous canals are intimately united with the surrounding and likewise hypertrophied connective tissue, in consequence of which arrangement the walls of these vessels do not collapse when mutilated, but remain more or less gaping. The lymphatics of the mucosa and the muscular tunic considerably enlarge. The nerves distributed to the uterus also share in the increased growth, especially the *ganglion cervicale*, which more than doubles its usual size.

The form of the uterus undergoes a marked series of changes during pregnancy. During the first three months the pyriform shape is retained; subsequently the organ becomes more expanded in its lower segment, and by the fifth month presents a form intermediate between the spherical and the pyriform, the longest diameter being vertical, and the antero-posterior dimension being greatest just below the middle of the body (Webster). Late in pregnancy the pyriform or egg shape once more predominates, owing to the dome-like distention of the fundus and the broadening of the lower segment.

During the early months all parts of the uterus increase with equal rapidity after the fifth month, however, the cervix participates but slightly in comparison with the rate of growth manifested in the upper part of the organ. While hypertrophy of the cervix is admitted by all, the extent to which this portio

of the uterus contributes to the formation of the excessive uterine sac present at the close of pregnancy is a question regarding which authorities greatly differ. It may be stated at once that the older view, that the cervical canal gradually unfolds itself into the uterine cavity as gestation advances, is no longer tenable, since the investigations of Müller so clearly showed that the cervical canal is but little affected. Regarding the question, however, as to what extent the cervix participates in the production of the uterine sac—whether it retains its integrity throughout the entire canal or contributes a part of its length to the enlarged muscular bag—the solution is less readily at hand.

The differences of opinion concerning these points have arisen more from differences in the interpretation of certain anatomical details than in their variation. It is of interest, therefore, to note the structural peculiarities as repeatedly observed in favorable preparations of the uterus at the close of pregnancy or at the beginning of labor. The classical section secured by Braune of a woman who died during the first stage of labor (Fig. 134) shows,

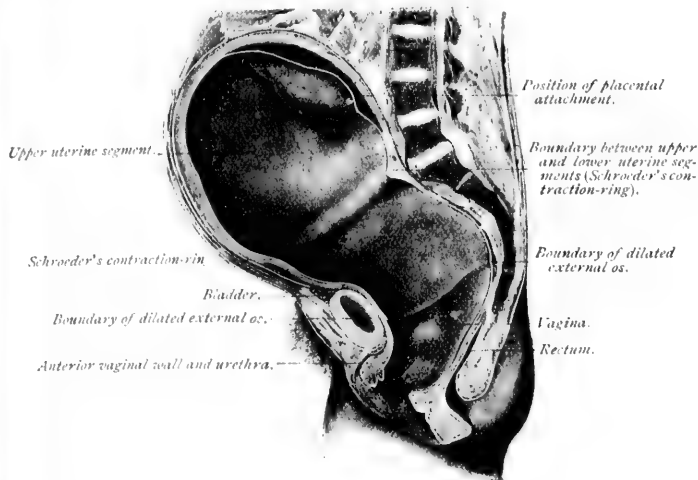


FIG. 134.—Section of the parturient canal at end of the stage of dilatation, from a woman who died during labor (Braune).

in addition to the widely dilated os externum, whose still-defined position indicates the juncture of the uterine and vaginal portions of the parturient canal, two annular markings of much interest. The uppermost of these markings is apparent as a distinct ridge completely encircling the uterine sac and separating the thicker and more voluminous upper segment from the more dependent lower part. This projection was described by Bandl as the dilated true os internum, and as defining, consequently, the upper limit of the cervical canal; by Schroeder the same structure was regarded as a *contraction-ring* which marks the juncture of the upper contracted and the lower dilated uterine segments. Some distance lower a second ridge, slightly marked

anteriorly, but more conspicuous on the posterior wall, constitutes Müller's ring, which Bandl regards as indicating the upper border of that part of the cervical canal which is unaffected until the dilatation of labor takes place. Schroeder, on the contrary, views this ridge as the true os internum, and the zone included between his contraction-ring above and the one in question below as the inferior segment of the uterus.

From the foregoing it is evident that the significance of the zone included between these two rings is the principal question at issue, some authorities regarding it as a part of the true uterine sac, while others consider it to represent the upper part of the cervical canal, that unfolds before the termination of gestation and thereby contributes to the extension of the uterine sac. According to the first view, the cervical canal retains its integrity throughout pregnancy; according to the second, the canal participates to a limited degree in the formation of the fetal receptacle by dilatation of its upper portion toward the close of gestation. While both views claim distinguished names in their support, the weight of evidence seems to lead to the acceptance of the doctrine attributing a limited participation of the cervix in the formation of the uterine sac of pregnancy.

The cervix of the uterus of the sexually mature virgin is about equal in length to the body of the organ, and only in women who have borne children is the neck relatively shorter (Kussmaul). During the first three months of pregnancy the cervix partakes equally in the general hypertrophy affecting the uterus (see Fig. 137), and reaches a length of 6 centimeters ($2\frac{3}{8}$ inches) or more.

While it is only from the seventh month that the os internum exhibits a tendency to expand into the adjacent uterine cavity, the forces leading to this unfolding begin their influence very much earlier—in fact, as soon as this portion of the uterus has reached its maximum hypertrophy, or from about the fourth month of gestation. In addition to the effects of the presence of the fetus, the traction exerted by the muscular bands—retractor fibres of Bayer—which pass from the outer layers of the uterus into the round and the sacro-uterine ligaments is an important factor in causing the gradual unfolding of the cervical canal. The dilated, funnel-shaped cavity contributed by the cervix for a long time retains its flattened plieæ and is covered by ciliated columnar epithelium; its mucosa finally undergoes conversion into the decidua by changes identical with those taking place in other parts of the uterine mucous membrane. As a result of these changes the cervical canal shortens, and at the close of gestation measures from 3 to 4 centimeters ($1\frac{1}{4}$ to $1\frac{1}{2}$ inches). The unfolding of the cervical canal takes place earlier in primiparæ, owing to the greater resistance of the comparatively rigid muscular tissue of the body of the uterus, until now unaffected by the changes of pregnancy. These changes result in a general softening and elasticity of the body of the uterus from the beginning of gestation, the cervix retaining its usual firmness during the earlier months almost unimpaired. Toward the close of pregnancy the vaginal portion of the cervix projects less and less, the seeming shortening being probably due, in part at least, to the swelling and greater

prominence of the surrounding walls of the vagina as well as to traction exerted by ascending and diverging muscle-fibres.

The change of position of the uterus is particularly associated with the rapid growth of the body, but during the early months of gestation this growth results in augmented antero-posterior and lateral diameters rather than in great increase of the longitudinal axis of the organ. In consequence of this increase, together with the increased antelexion resulting from the additional weight of the hypertrophied tissue, the fundus does not rise above the symphysis until the fourth month. The fundus lies usually to the right of the median line, and often is so turned on its long axis that the left side is directed forward. At the fifth month the uterus fills the hypogastrium, from which time on the rise in the position of the fundus is so regular in its progression that under normal conditions this detail furnishes valuable assistance in the estimation of the stage of pregnancy. During the last two weeks of gestation the uterus sinks within the pelvis, the fundus taking a position somewhat lower than before, resting downward and forward from 7 to 8 centimeters ($2\frac{3}{4}$ to $3\frac{1}{4}$ inches) below the ensiform cartilage. The observations of Webster led this investigator to believe that the sinking of the uterus not infrequently begins long before (sometimes from the fifth month) the last two weeks, the period usually assumed.

The position and relations of the full-term uterus alter with the posture of the woman. In the upright position the fundus bends as far forward as the tension of the distended abdominal walls permits, and rests against the anterior parietes. In the recumbent position the uterus lies against the lumbar part of the vertebral column, the fundus approaching the diaphragm above, with the intestinal coils in front and at the sides. On assuming the lateral posture the large, flaccid uterine sac becomes dependent on the corresponding side.

The relations of the *peritoneum* and the uterus become disturbed in consequence of the altered position of the latter and the excessive tension caused by its enormous proportions. The layers of the broad ligaments become gradually separated and the entire structures shortened, in consequence of which the Fallopian tubes and the ovaries are drawn toward the uterus, against which they lie at the close of gestation.

The changes in the disposition of the pelvic peritoneum during pregnancy have been by no means definitely determined, and opinions differ as to the forces leading to such alterations as well as to the extent of displacement. Regarding the lateral arrangement, it is evident that the increase in the transverse and vertical diameters of the uterus must result in the elevation of the peritoneum on each side of the pelvis to a considerable degree, as conclusively demonstrated by the observations of Barbour and Polk. The arrangement in front and behind, however, is not so clear, and the statements of authorities are conflicting. Polk maintains that the lowest situation of the peritoneum in front and behind the uterus, with the exception of Douglas's pouch, in the non-pregnant condition is indicated by a line passing from the centre of the

symphysis to the juncture of the third and fourth sacral vertebræ. At the termination of pregnancy, but before the usual sinking of the uterus within the pelvis has occurred, the lowest limit of the peritoneum, according to the same observer, has ascended and is now marked by a line passing from the centre of the symphysis to the sacral promontory.

These conclusions are not confirmed by examinations of frozen sections made by Webster, since this author finds the inferior limit of the peritoneal pouches during pregnancy as low as in nulliparæ. The changes in the anterior relations of the peritoneum of the vesico-uterine fossa, whereby the peritoneum becomes stripped from the bladder, are usually regarded as due to the elevation of the uterus and to the consequent mechanical effect, which together are also supposed to exert an influence by which the floor of the pouch of Douglas is raised. Webster attributes the stripping of the peritoneum from the bladder, on the contrary, to the drag caused by the gradual sinking of the pelvic floor, since the delicate subserous tissue gives way under the traction, and the peritoneum consequently does not follow the posterior wall of the bladder in its descent. The extent to which the stripping of the serous covering takes place depends largely upon the capacity of the peritoneal folds existing in the non-pregnant condition, as when these are ample less displacement follows than when the traction cannot be met with supplementary tissue. According to Webster, the central portion of the pouch of Douglas at no time during pregnancy becomes elevated; this author further points out that the sinking of the uterus may be progressive from the middle of pregnancy, resulting in the marked downward displacement of the organ sometimes observed before the end of gestation.

The vagina also exhibits changes resulting from the exaggerated nutrition of pregnancy. These changes include greatly increased vascularity, thickening and softening of its mucous membrane, whose folds become less rigid and conspicuous, and hypertrophy of the muscular tunic with great dilatation of the blood-vessels. In consequence of the large quantity of blood contained within the less compact tissues, the vaginal surface presents a bluish tint in contrast with the bright red of its usual condition. This change of color is regarded by some as a valuable objective sign of pregnancy.

The external genitals likewise participate in the increased hyperemia of the generative tract, the unusual development of the blood-vessels and the lymphatics inducing a condition characterized by softening and greater infiltration of the tissues, hence the vulva appears particularly prominent. The excessive vascularity of the parts finds expression in the dusky hue and the unusual activity of the sebaceous follicles and the sweat-glands of the labia.

The articulations of the pelvis exhibit to a limited degree changes due to pregnancy. These changes are manifested by an unusual softening and vascularity of the interarticular cartilage, particularly that of the symphysis, in consequence of which there takes place a certain amount of loosening, attended in some cases with slight movement. Whatever temporary increase in the pelvic boundary may thus be secured, the gain at best is probably very insignificant.

Other changes affecting the *pelvic floor* and the parts closely connected therewith, such as the base of the bladder and the urethral orifice, result from the downward displacement of the structures closing in the outlet of the pelvis. The pelvic-floor projection is progressively increased from 2.5 centimeters (1 inch) in the nullipara to 9.5 centimeters (3 $\frac{3}{4}$ inches) at the end of pregnancy; the skin-distance from the symphysis to the coccyx is almost doubled.

The following table, compiled by Webster, based on the observations of himself and of other observers, displays some of the more important variations induced by pregnancy within the parts in relation to the pelvis:

	NUL- LIPARA.	FIFTH MONTH.	EIGHTH MONTH.	NINTH MONTH.
	Cm.	Cm.	Cm.	Cm.
Pelvic-floor projection	2.5	4.1	5.0	9.5
Skin-distance from coccyx to symphysis	13.5	14.0	16.5	25.5
Distance of urethral orifice below brim	6.1	6.7	6.7	9.5
Distance of urethral orifice below symphysis	0.6	2.5	3.2	3.2
Distance of junction of bladder and urethra below brim	6.4	7.6	6.3	7.0
Thickness of tissue between pubes and vagina	1.6	2.8	3.5	4.4
Depth of utero-vesical pouch below brim	5.7	5.5	6.7	6.0
Distance of os externum below brim posteriorly	6.3	11.1	8.7	8.9
Distance of os externum below brim anteriorly	6.3	11.1	8.7	9.2
Distance of os internum below brim posteriorly	5.7	7.9	7.0	6.0
Distance of os internum below brim anteriorly	5.7	7.9	7.0	6.7

The *abdominal walls* manifest the enormous distention to which they are subjected by the formation of more or less conspicuous lines—the *strie gravidarum*—which are found in over 90 per cent. of pregnant women. These lines appear as reddish or bluish, sometimes lighter, streaks, which are most numerous and well marked during the last months of pregnancy over the lower part of the abdomen, particularly at the sides. They extend as curved or sinuous lines, and they persist for some considerable time after the termination of gestation, gradually becoming whiter and more cicatricial in appearance. These striae are due to displacements and partial rupture and atrophy of the connective tissue of the deep layer of the greatly distended cutis. They are not peculiar to pregnancy, but may appear even in men whenever the skin is subjected to unusual stretching, as from tumors, ascites, and other causes; furthermore, they are not limited to the abdomen, but in pregnancy are seen on the nates, the thighs, and the breasts.

The *linea alba* also not infrequently becomes broader, and in multiparæ the recti muscles are sometimes so widely separated that the mass of the uterus appears between as a median projection.

The *umbilicus* is affected by the increasing bulk of the abdominal contents, and by the fifth month begins to exhibit a diminution in its depths; by the seventh month its depression has become obliterated, and during the remaining weeks it becomes gradually everted until the umbilicus forms a rounded elevation.

The *mammary glands*, coincidently with the changes affecting the generative organs, undergo important alterations during the preparation for their assumption of the stage of functional activity. These changes early induce

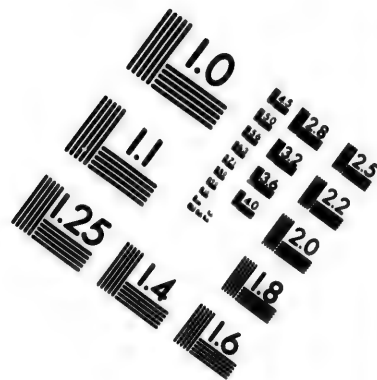
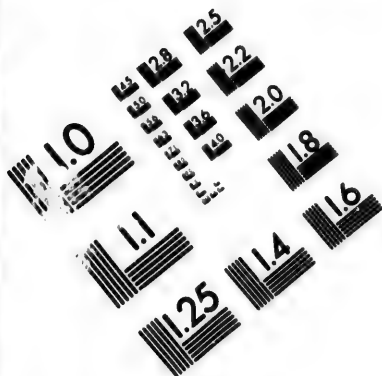
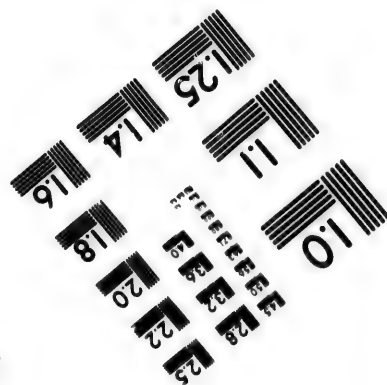
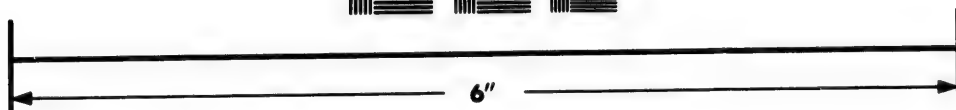
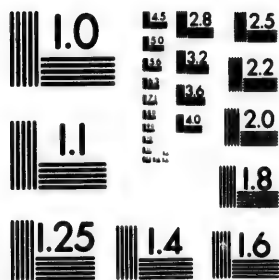


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greater general volume in the breasts, depending upon an increase both of the interlobular connective tissue and fat and of the true secreting tissue of the glands. The enlargement of the breasts begins as early as the second month, but it does not become conspicuous until toward the middle of preg-



FIG. 135.—Virgin nipple and areola: 1, nipple; 2, areola; 3, tubercles of Morgagni; 4, crevice at base of nipple.

nancy. On touch the periphery of the organ presents uneven and knotty masses consisting of the enlarged acini and lobules of the rapid-growing glandular tissue imbedded within the areolar and adipose tissue. The ultimate compartments of the secreting structure become earliest enlarged; conse-

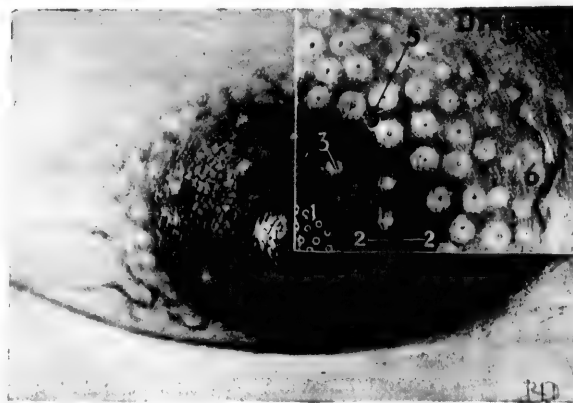


FIG. 136.—Nipple and breast of pregnancy: 1, nipple with openings of milk-ducts; 2, primary areola; 3, glands of Montgomery; 5, secondary areola; 6, venous circle of Haller.

quently the increase is first noticeable at the periphery, afterward extending along the course of the larger ducts toward the centre of the organ. The distention of the skin due to the augmented volume of the glands is especially marked over the periphery, in which location reddish, bluish, or whitish striae,

similar to those seen upon the distended abdominal walls, appear as manifestations of the unusual tension of the integument. The veins are also enlarged, and show through the tightly drawn skin as a network of blue lines.

The nipple shares in the general hypertrophy of the organ, becoming enlarged, more readily erectile, and sensitive. The surrounding rosy areola of the virgin (Fig. 135) is gradually replaced by a more deeply colored area, whose tint by the middle of pregnancy varies from the slight brownish discoloration seen in women of light complexion to the dark brown or almost black color seen in brunettes (see Pl. 17). The areola by the eighth or the ninth week becomes softer and more elevated than usual, and its sebaceous glands, from one to two dozen in number, greatly enlarge, those at the periphery becoming particularly conspicuous. These enlarged sebaceous follicles constitute the glands of Montgomery (Fig. 136). The mammary areola varies from 2.5 to 4 centimeters (1 to 1½ inches) in diameter, although these dimensions may greatly be exceeded. In the fifth or the sixth month of pregnancy an additional irregularly pigmented area, the so-called "secondary areola," sometimes appears (see Pl. 17).

After the third month of gestation the breasts contain a thin fluid, the colostrum, which may be pressed out of the newly formed glandular tissue. This fluid consists of a thin albuminous medium containing numbers of fat-drops, displaced epithelial cells, and characteristic aggregations known as "colostrum-corpuseles."

2. General Changes.—Pregnancy, while a purely physiological condition, creates great and important changes in the maternal organism. These changes pertain to the different systems and organs of the body; to some more than to others. The general changes in the maternal organism depend to a great extent on the alterations in the blood and in the functional modifications of the nervous system. The pregnant woman has to provide nutriment, to breathe, to maintain blood-circulation, to secrete and to excrete for two individuals—herself and her fetus. All this means that extensive changes in the general system must occur. If these changes are carried to a reasonable extent, health is maintained and the system becomes fortified, as it were, for the coming parturition; but when these changes are developed to excess, disorders complicating the pregnancy are produced.

Changes in the Circulatory System.—Formerly it was supposed that pregnancy was accompanied by blood-changes like unto plethora, and it was almost universally inferred that the attending symptoms—the headache, the ringing in the ears, the flushed face, the cardiac palpitation, and the dyspnea—were the results of these alterations. Consequently it was a very common practice with physicians many years ago to bleed pregnant women from one to many times at intervals during the latter months of pregnancy. Enormous quantities of blood were thus extracted by venesection. A wonderful revolution has taken place in the treatment of pregnant women during the past twenty-five years, owing to more rational ideas of the real condition of the circulatory fluid.

In pregnancy the composition of the blood, which is increased in quantity, is profoundly altered, as many careful analyses prove. The quantity of blood present before pregnancy would be inadequate to meet the condition of pregnancy. Thus, the blood is increased in its watery elements and white corpuscles, but is made deficient in the element of albumin, is increased materially in the amount of fibrin, and is diminished in the proportion of red corpuscles—conditions of anemia, hydremia, and hyperinosis. This hyperinosis is also augmented after parturition, because at this time large quantities of effete materials are thrown into the circulation.

Instead of a blood-change called "plethora" being present, it should be recognized as one of anemia and hydremia or of chlorosis. If called "plethora," it should be named *serous plethora*. Individual variations in the quantity and quality of the blood are dependent on many conditions of hygiene and diet; poor hygiene reduces the blood to marked chlorosis and hydremia. The surrender of the maternal nutritive material to a growing fetus and a developing uterus, to pelvic tissue, and to glands means a great tissue-drain on the maternal circulatory fluid. As these changes in blood-quality are most marked at the close of utero-gestation, the attending phenomena must be those that are most strongly shown. Certain thrombotic affections observed in pregnancy and after delivery are thus explainable. In place of the blood-supply at this time being improved by bloodletting, it must clearly be evident that venesection is strongly contra-indicated, for it tends further to aggravate the abnormal alteration. To Cazeaux are we indebted for much of our present knowledge of the blood-changes of pregnancy.

Certain viscera of the circulatory apparatus are also much modified in size and in function. The heart becomes physiologically hypertrophied—a fact known for many years and determined by numerous observations. This hypertrophy is a wise provision of nature to meet the increasing exigencies of the blood-supply in the advancing months of pregnancy. Hypertrophy of the heart is constantly present to a considerable degree, the whole weight of this organ being one-fifth more in the pregnant than in the non-pregnant state. The left ventricle, the propelling part of this organ, is alone affected. This physiological hypertrophy remains during the period of lactation in those who suckle their children, otherwise the organ quickly diminishes in size; hence in women who have borne many children the heart may remain permanently large. Incident to the total blood-supply in pregnant women the maintenance of the circulation demands either greater frequency in the heart-contractions or an increase in the entire quantity of blood entering the left ventricle. The multiplied vascular elements of the pelvic organs also increase the labor thrown on the heart.

Disturbances of the circulatory organs are very often seen. Thus, palpitation, while purely sympathetic in the earlier months of gestation, later come on from the encroachment of the enlarged and enlarging uterus pushing up the diaphragm and embarrassing the heart's action. The blood-changes of anemia and of hydremia may be so great that edema

may be observed in the feet and may extend upward to the thighs and the labia majora.

Other organs are likewise increased in size. The liver and the spleen are enlarged. The spleen normally increases in size, owing to an important relation to the quantitative change in the circulatory fluid. A fatty degeneration shows itself in both the liver and the spleen in women who have suddenly died after labor. Numerous small yellow spots are seen scattered through the liver—fatty deposits in the hepatic cells. The thyroid gland is increased in size. In women in whom there is a predisposition to this enlargement, pregnancy may further stimulate the growth and bring about permanent structural changes. The enlargement, of this organ is thought to sustain some relation to changes in the heart and the blood-glandular system.

Changes in Respiration.—Pressure of the enlarging uterus, through mechanical action, causes changes in the respiratory organs. An upward movement of the diaphragm lessens the longitudinal dimensions of the thorax. Some embarrassment of the respiration follows this decrease, notwithstanding that there is some increase in the breadth of the lower thorax. In the last two weeks of utero-gestation, owing to the limited shortening of the cervix uteri and to the settling down of the fetus *in utero*, respiration and circulation become easier.

As more blood must naturally be provided to nourish the woman and her child during pregnancy, this extra blood must not only be properly circulated, but must also be duly purified. The elimination of carbonic-acid gas by respiration is therefore increased in pregnancy.

The respiratory organs may be deranged by cough and dyspnea originating from nervous sympathy in the earlier months of pregnancy. In the later months of gestation the derangement is from encroachment of the gravid uterus, interfering with normal respiration. These phenomena are mostly observed when there is twin pregnancy or dropsy of the amnion.

Changes in the Digestive System and in Nutrition.—The pregnant woman provides the nutritive pabulum by which the growing organs are sustained and by which the fetus and its appendages are built up. She must therefore digest more food, form more blood, and increase the activity of the secretory and excretory organs. Very few women escape such troubles of digestion as nausea and vomiting. In the earlier months the appetite is, as a rule, capricious. Further along the appetite and the digestion increase in activity, thereby assisting in improving the general nutrition.

An increase of weight takes place in normal cases, irrespective of the growing uterus and the ovum. The average gain amounts to from ten to fifteen pounds in the whole nine months, being greatest in the last two months. This increase is not far from one-thirteenth of the whole body-weight, and it is progressive from the beginning to the end of pregnancy, notwithstanding the nausea and vomiting.

The adipose tissue increases most in bulk, especially in the latter half of gestation. These deposits are most noticeable in the mammary glands, in

the abdominal parietes, in the hips, and in the omentum. The whole figure becomes fuller and rounder. All this increase is but so much stored-up potential energy, to be utilized after delivery, when this energy, by the metabolism of the body, assists the mammary function.

Rokitansky has spoken of the lamellæ of osseous material on the inner surface of the skull and the frontal and parietal bones external to the dura mater, called "puerperal osteophytes." These lamellæ, which are irregular in shape, consist of calcium carbonate, traces of phosphates, and organic matter. They are not peculiar to pregnancy. Robert Barnes thought they sustained some relation to the calcareous changes found in the placenta and to the forthcoming milk. The temperature of the body in pregnancy is not materially changed, although, according to some authorities, it is slightly lower in the morning than during the day.

Changes in the Skin, the Gait, and the Osseous Elements.—The functional activity of the sebaceous glands, the sweat-glands, and the hair-follicles of the skin is increased by pregnancy. It has been said by Robert Barnes that the growth of the hair is invigorated during pregnancy when prior to gestation the hair had been falling out.

Pigmentations are quite generally observed in spots over the body, the lineæ albicantes being most noticeable. They are also seen about the abdomen, the navel, and on the face. Around the nipples these deposits may be seen in the form of areolæ, primary and secondary (see Pl. 17). These pigmentations vary much in extent and in intensity in different subjects, being more marked in brunettes than in blondes. Seldom do these deposits completely disappear, but they are always less after parturition. It is not unlikely that they are the result of a temporary hypertrophy of the suprarenal capsules.

There is also a change in the gait of a pregnant woman. To preserve the centre of gravity of the body the head and shoulders must be thrown backward. This action produces a change in the gait most noticeable in women of low stature.

Owing to the drain on the osseous elements of the blood during pregnancy by the growing fetus, there is always a considerable delay in the union of fractured bones.

Changes in the Urine.—Owing to the hydremic condition existing during pregnancy, the urine becomes more abundant and of a lower specific gravity. It is thought that the kidneys become enlarged, which is probably the case. This change in the size of the kidneys has somewhat to do with the increased quantity of urine, but more probably the more active function is attributable to the increased blood-supply and to the increased arterial tension.

There are also qualitative changes in the urine. The chlorids have been found increased, while the phosphates and sulphates are decreased, due to their use in the growth of the fetus. The kiestein pellicle found upon the urine of pregnant women several hours after its excretion has no necessary relation to pregnancy, because it is found on the urine of virgins and on that of men.

The glucose found in the urine of many pregnant women in variable

quantities has been referred to a pathological increase in the glycogenic function of the liver. Sugar is present in the urine of almost every woman at some period of lactation being influenced much by the character of the diet. Its presence depends on the quantity and quality of the milk, diminishing as the lacteal secretion is suppressed.

Traces, more or less in quantity, of albumin are found in the urine. Authorities differ as to the frequency of albuminuria in pregnancy. Schroeder says that the urine of all pregnant women will contain albumin in from 3 to 5 per cent.; other authors have contended for a much larger percentage (from 20 to 30). Unquestionably, albumin is found in the urine of a very large number of pregnant women. No regard being paid to the number of pregnancies, nor to the previous condition of the kidneys, the presence at some time of a trace of albumin will be found in a very large number of cases. The writer, who instituted these examinations in a large clinical experience in hospitals, has found the frequency to be at least 30 per cent. This frequency must be inquired into with reference to its etiology. In the first place, quite a number of pregnant women have a physiological albuminuria. The trace of albumin is then small and of short duration; there are no tube-casts, and no attending morbid symptoms. Every authority must coincide with Möricke, that albuminuria is relatively commoner during labor than during pregnancy. A prolonged labor is oftener thus accompanied than is a short and easy labor. Albuminuria is often confined exclusively to the period of labor. The occurrence of albuminuria during labor is explained by the theory that the reflex vaso-motor spasm of the renal arteries, resulting from uterine contractions, causes renal anemia. This theory has the support of Tyler Smith, Spiegelberg, and others.

Renal albuminuria may appear early in pregnancy, before there is any possible renal venous stagnation from pressure, being the result purely of reflex irritation. Why should not this irritation at times be transferred from the uterus to the kidneys as well as to the stomach? Such an explanation must hold good, if albuminuria is present early in pregnancy, the urine having been normal before that time. There is an intimate connection between the nervous ganglia of the pelvis and the nerve-filaments of the kidneys.

The hydremic state of the blood incident to pregnancy is at times a cause of albuminuria. An increased arterial tension which exists in pregnancy may be productive of albuminuria. The urine of a pregnant woman may be albuminous from causes not nephritic, yet morbid. Thus, it may be albuminous from blood, from mucus, or from pus in the urine, each of which may be cystic, vaginal, or uterine in origin.

The prevalence of albuminuria during pregnancy may be classified as follows: (a) Cases in which it was present when conception took place, a chronic Bright's disease of some type, with albuminuria, having existed before pregnancy; (b) Cases in which albuminuria from sub-acute or chronic Bright's disease, the result of scarlet fever, etc., had existed years before, and from which disease a recovery seemingly had taken place: at least there was no

trace of albumin in the urine at the time of conception ; (c) Cases in which the existing pregnancy or parturition was attended by an albuminuria, it having never existed before.

In the first two divisions of the above classification pregnancy aggravated or caused a return of the albumin. In the last division albuminuria started during, and had been clearly attributable to, the condition of pregnancy.

Excepting, then, the cases in which the albuminuria has been due to physiological or pathological causes, not nephritic, and not attributable to pregnancy, the author is disposed to think that the estimate made by Schroeder (3-5 per cent.) is not wide of the actual facts.

The oldest theory is that albuminuria and kidney disease during pregnancy are due to mechanical pressure of the gravid uterus on the renal blood-vessels, especially on the veins. All admit that this mechanical pressure predisposes to, if it does not excite, the disease. This doctrine has been ably advocated by Simpson, Carl Brown, and Cazeaux. It is not so much the renal pressure alone as it is the intra-abdominal pressure that so acts. Support of this theory is obtained from the following facts :

Albuminuria is more common in the latter half than in the first half of pregnancy. More cases exist among primiparæ, in whom there is great abdominal pressure from the rigid, unyielding abdominal walls. Albuminuria is greater in twin pregnancy ; it is also common when there is a severe pressure from large uterine fibroids or from ovarian cysts. Tight lacing and heavy skirts aggravate the disease. It is less frequent during gestation than during labor, when pressure is greatest ; it diminishes after labor or after the removal of the abdominal tumors. Any cause that brings about renal venous stasis predisposes to and excites nephritis. For instance, valvular defects and pulmonary emphysema, as well as pregnancy, may develop true parenchymatous inflammation of the kidneys.

No one of all the above theories or facts constitutes a sufficient explanation for all cases. Each fact or theory may answer for some cases ; two or more combined afford a better solution for most. All can recognize the influence of intra-abdominal tension with pressure on the vena cava and its branches, especially in primiparous women. The sinking of the fetal head into the true pelvis in the last two weeks of pregnancy, while it improves the respiration and circulation in general, does not relieve the renal venous stasis. While most women feel lighter and freer during these last two weeks, owing to the settling down of the fetus from the shortening of the cervix, the intra-abdominal and pelvic pressure is not diminished.

So great is the significance of albuminuria during pregnancy that its presence should always be watched for. Frequent physical, chemical, and microscopical examinations of the urine should be made in the latter months of pregnancy. If the presence of albumin is but slight, it may be physiological, or, if pathological, no noticeable symptoms may be observed ; but if it is considerable and persistent, and if it occurs early in pregnancy, the prognosis is grave. Albuminuria is then a condition full of ill omen, although it is always

susceptible of amelioration by well-directed treatment, and in many cases it may entirely be overcome.

From a clinical standpoint it is ordinarily presumed that when there is albuminuria there is also uremia to a corresponding degree. Doubtless it is true that when albumin is abnormally excreted by the kidneys there is some retention of urea in the blood, from defective action of the kidneys, but certainly these two functional disorders do not hold the same proportion or relation. There may be much albuminuria and but little uremia, and *vice versa*. It is the degree of the latter disorder that forebodes evil. The whole line of treatment should be directed toward favoring the elimination from the blood of this poisonous material of urea, with its products. To secure this result it is incumbent upon us to act as potently as we can upon the bowels and the skin—compensatory organs of the kidneys—and to address our remaining treatment to controlling other symptoms that may arise.

Changes in the Nervous System.—The nervous system becomes more impressionable in pregnancy. The emotional susceptibility is markedly increased and the whole character is altered. A woman may become fretful, peevish, irritable, and at times unreasonable. The most amiable woman may thus be disposed when pregnant. She is often depressed in spirits at first, when her general nutrition is impaired from an imperfect appetite or a faulty digestion. Mania may be excited later on—easily in those who are thus predisposed by inheritance or by actual melancholia. These conditions are among the most troublesome of the various complications of pregnancy. To witness a woman in the process of child-bearing impaired in her mental functions is indeed sad. There are cases, however, in which a sense of well-being takes the place of one of more or less physical debility. A condition of want of mental and physical activity before pregnancy at times becomes changed to one of buoyancy and exhilaration. Physically such women are stronger, and mentally they are more active and energetic. No factor enters so much into the causation of this mental cheer and despondency as the psychological—the degree of the desire for an offspring.

II. DIAGNOSIS OF PREGNANCY.

1. SYMPTOMS AND SIGNS OF PREGNANCY.

1. *The Nausea and Vomiting of Pregnancy, called the "Morning Sickness."*—This symptom consists of nausea, accompanied often with vomiting or the retching of a glairy fluid, showing itself early in the morning, generally before, at times only after, breakfast. The assumption of the erect posture seemingly excites the disorder. Sometimes it begins very early, within a few days after conception, but usually not until the fourth or the fifth week of pregnancy. Seldom does it persist throughout pregnancy, but generally ceases spontaneously within the fourth month, although it may continue

throughout the whole period. In many or in most cases it is comparatively mild, and does not seriously impair the health, its presence being regarded as a favorable omen; but as there is every degree of seriousness in its nature, it is at times so severe and so long continued that not only are parts of meals vomited, but all foods, of whatever kind, variety, or quantity, are also rejected. Not only may the ingestion of food excite vomiting, but the sight or the smell of food may also give rise to this characteristic nausea.

Morning sickness is a sympathetic disorder reflected from the uterus. It is aggravated by unpalatable food, by sexual excitement, and by emotional disturbances. It is most marked in first pregnancies, and in women of highly nervous organization—a fact ever to be considered in the management of this affection. It is a suspicious or presumptive evidence taken by itself, but when associated with certain other symptoms and signs it becomes a more probable symptom of pregnancy. Not necessarily in the regular order of time, but quite generally associated with this morning sickness, there are certain morbid longings for food; for instance, foods and drink and certain vegetable acids formerly disliked are now desired; the most unpalatable substances, such as chalk, clay, and slate-pencils, may be craved; or there may be a distaste for the usual articles of diet. Other stomach disorders, such as acidity, flatulency, heartburn, and unpleasant eructations, are sometimes noticed.

Salivation is a very common accompaniment of the morning sickness when the latter is severe. A constant dribbling of the saliva by day or by night occurs in the earlier months of pregnancy, and its severity and duration remain for an uncertain period. It has been observed to continue for months after the abatement of the nausea and vomiting.

Toothache.—Under the above heading may also be included toothache, which at times is a purely functional disorder; more often it is a symptom of actual caries, arising from alteration of the buccal secretion, dissolving the lime-salt of the enamel of the teeth; or it may be the result of a morbid determination of the ossific elements of the teeth of the mother to the bones of the growing fetus.

2. Menstrual Suppression.—The second symptom more or less expressive of the existence of pregnancy is the suppression of the menses. The function of menstruation is almost always suspended throughout the whole period of pregnancy. So reliable is this symptom that the determination of the end of gestation, or the time for the expected parturition, is best obtained by adding from two hundred and seventy-eight to two hundred and eighty days to the date of appearance of the last menstrual flow. But not invariably is menstruation suspended following an impregnation. The most frequent exception to the general rule is found when menstruation returns once only; then it is usually for a somewhat shorter time and in diminished quantity. The occurrence of a menstrual flow in diminished quantity and for a shorter time in a married woman who has had her menstrual periods regular as to time, quantity, and duration is very significant of a possible pregnancy, and the conception must have occurred several days before this function last appeared.

Again, by way of exception to the rule, there are recorded notable instances in which the period of pregnancy was attended by a regular menstruation. The writer recalls in his experience the case of a woman, now living and in health, who never menstruated before marriage, nor during her married life of several years unless she became pregnant. She had no menstruation the first two years of her married life until pregnant, and there was no return of the menstrual flow until she was again pregnant; in other words, menstruation in this case was never present except during pregnancy, when it was normal in all regards, having thus appeared in three distinct pregnancies. Possibly the periodic hemorrhage in this case was of cervical origin, but no pathological lesion of the uterus could be detected. Menstruation occurring during the first three months of pregnancy may come from the decidual cavity of the uterus, not yet closed, before the decidua vera and the decidua reflexa have become agglutinated; then there must have been a certain amount of chronic decidual endometritis—a morbid state, of course.

As many causes purely pathological—general and local, physical and psychical—induce menstrual suppression, the exact significance or the relative value of this symptom, as an evidence of the existence of pregnancy deserves most careful consideration. For instance, menstrual suppression following months and years of menstruation, normal in all regards, is a very strong suspicion of pregnancy. Its value as evidence becomes less when it is stopped in a woman whose previous periods have been irregular from any cause. This symptom of menstrual suppression cannot, of course, be present from pregnancy when the menses are physiologically absent from lactation, or when the pregnancy occurs before the first menstrual appearance, prior to puberty or after the menopause. So much faith has the popular mind in the presence of this symptom of menstrual suppression as indicative of pregnancy that no small degree of anxiety in looking forward to a pregnancy is often manifested by women. There is what is called “psychical amenorrhea,” in which case menstruation is suspended or is delayed from purely psychical causes. While it affects newly-married women who may be anxious to avoid pregnancy, it concerns mostly unmarried women who have exposed themselves to the possibility of impregnation. The fear of a possible pregnancy is doubtless sufficient to prevent a normal return of this function.

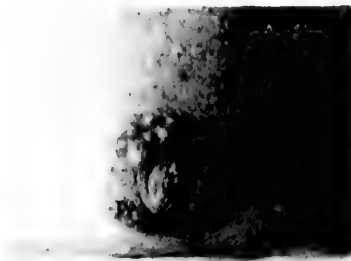
All the exceptions above mentioned should ever be held in mind in estimating the actual worth of the symptom of menstrual suppression.

3. Mammary Changes.—During pregnancy the mammary glands are in immediate sympathy with the growing reproductive organs of the pelvis, consequently a genuine physiological hypertrophy commences in these organs from the beginning of gestation. Their glandular structures become larger, fuller, and firmer; a sensation of weight or of pricking in them is felt by the patient; the veins, blue in color, become enlarged and more visible. Light-colored, silvery lines are seen radiating over the projecting organs in the last months of pregnancy. The nipples also become enlarged, more elongated, prominent, and somewhat erect (Pls. 17, 18). Surrounding the nipple is noticed the

areola, which becomes darker in color, and which is most pronounced in brunettes (Pl. 17). Two or more enlarged moist follicles, varying in size and containing sebaceous material, are seen projecting from the surface of the areola. In the fifth or the sixth month there appears a secondary areola (Pls. 17, 18) consisting of scattered round spots, appearing as if the color had been discharged as a shower of drops (Montgomery). Thus every structure entering into the composition of the mammary glands is physiologically hypertrophied. These changes begin as early as the second month, and become more pronounced as pregnancy proceeds. The two mammary glands are equally enlarged and progressively developed. The secretion of colostrum in the glands enhances the value of these mammary changes indicative of pregnancy, especially if noticed in women who have never before been pregnant. Milk is now and then seen to ooze from the nipples of some women before delivery (Pl. 17); in most women a drop or more of colostrum may be squeezed from the nipples after the third month. Instead of the lacteal secretion being promoted, its suppression in nursing women is very suspicious of another pregnancy. Milk is secreted at times, though rarely, when there is no pregnancy. Pelvic diseases, such as chronic metritis, rapid-growing fibroids, ovarian cystomata, and false pregnancy, at times induce milk-secretion. Cases are recorded of the presence of milk in the mammary glands of males. These characteristic physiological changes, in their uniformity and progressiveness, mark the distinguishing differences between the mammary changes of pregnancy and those alterations noticed in size and shape of the glands from sympathy with certain pelvic diseases—ovarian and uterine.

These mammary changes in structure, color, and function are of little diagnostic value when considered alone, but when taken in conjunction with other symptoms they are highly probable evidences, especially in first pregnancies. Owing to the fact that the darkening of the areola in multiparæ, and the erectility of the nipple remain more or less prominent, while colostrum may sometimes be present for years after the cessation of lactation, it can be appreciated how these signs lose their diagnostic value in women who have borne children.

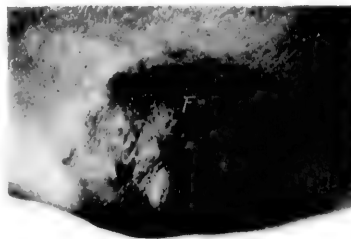
4. Functional Disturbances of the Bladder.—Functional disturbances of the bladder are quite often noticeable early in pregnancy. As the bladder is somewhat dragged upon by the physiological prolapsus of the uterus in the first month (a position rather increased in the second month), and as it is pressed upon during the third month by the increasing normal anteversion, it can be understood why functional disorders of this organ may result. The bladder-capacity is diminished, and in consequence there is an increased frequency of urination. The vesical symptoms tend to diminish in the fourth month, because of the ascent of the uterus from the pelvic to the abdominal cavity. If retroversion of the uterus existed prior to pregnancy, this backward malposition is increased, while the uterus is pelvic in position. Because of the increasing size of the organ, with its growing contents, there follows, at times, from retroversion, serious urinary retention. Incontinence of urine more



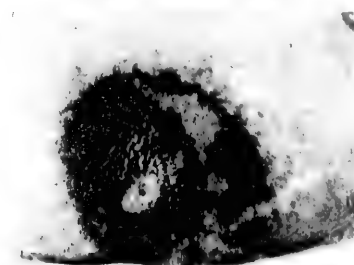
Primary areola, elevated and edematous (PA), with follicles (in a blonde).



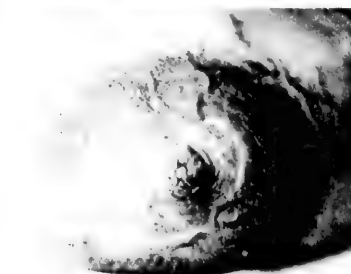
Primary areola, pigmented (PA), but flat, with small nipple (in a brunette).



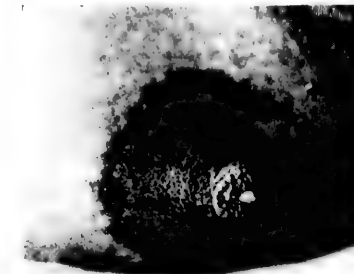
Montgomery's follicles (F), largely developed.



Erectility of nipple and primary areola.



Veins coursing over the breast and primary areola, with irregular pigmentation (in a blonde).



Milk, with faint secondary areola (in a brunette).

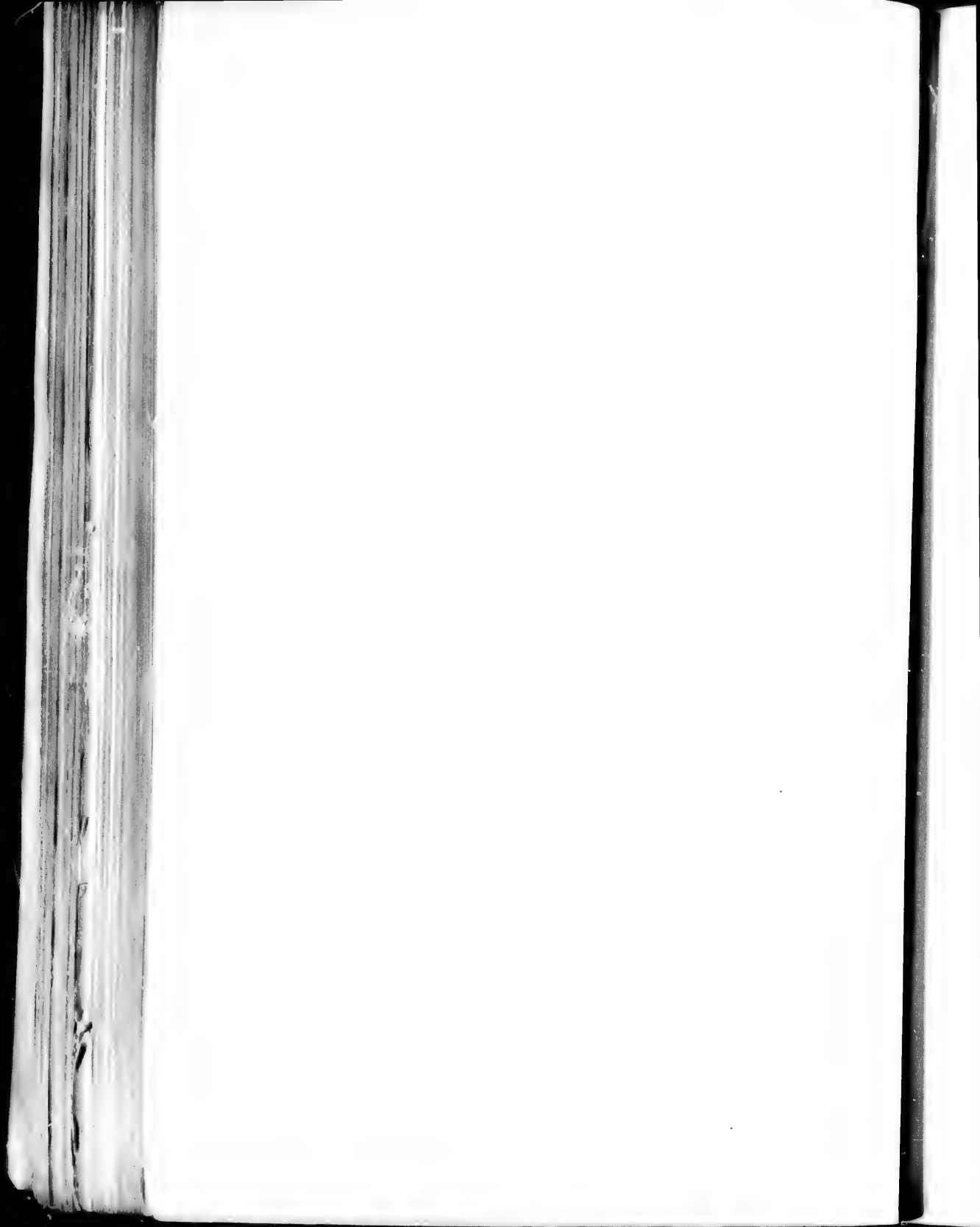


Secondary areola of usual size (in a brunette).



Secondary areola, prominently marked (S), with wide primary (P) areola (in a brunette).

Mammary signs of pregnancy in their order (two-thirds life size).

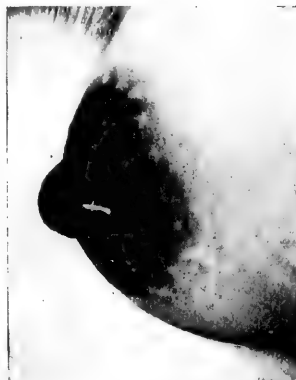




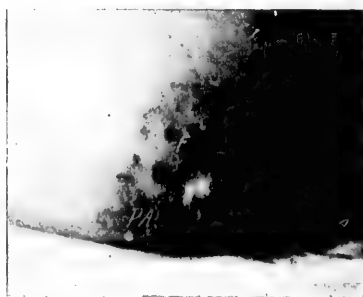
Elevation of primary areola (E) in profile, compared with an areola which is not elevated (composite photograph).



Well-formed, firm breast and nipple (in a brunette).



Typical signs in a brunette, including follicles and primary and secondary areolae.



Typical signs in the blonde: F, follicles; PA, primary areola.

Mammary signs of pregnancy.



rarely occurs during pregnancy, from coughing or from sneezing, when the bladder is somewhat distended.

Kiesteine, sometimes present in pregnant women, is a proteine substance, consisting of triple phosphates, fungi, and infusoria, that forms like a flocculent cloud on the urine kept standing for a few days at a temperature of 70° F. It occurs in the urine from the eighth to the thirty-second week of pregnancy, then disappears. It has practically no diagnostic value, as it is found in the urine of non-pregnant women, and at times in that of men.

5. Intrapelvic Signs.—Certain changes in structure take place in the uterus in the earlier months of pregnancy, when the organ is confined within the true pelvis, before it ascends within the abdominal cavity; these changes, carefully studied and detected by vaginal touch and by bimanual examination, possess a significance far greater than any of the aforementioned symptoms. Associated with some of the other symptoms, these changes become extremely probable evidences:

(a) *Softening and Enlargement of the Cervix Uteri.*—These changes, compared with the physical conditions of the same parts in the virgin or the never-pregnant woman, will be observed to be quite characteristic—less so in women who have borne children. The cervix uteri softens and enlarges in all directions. The lips of the os uteri become patulous and puffy, a condition most noticeable in primiparæ. The softening of the infravaginal cervix, beginning below, extends upward. The cervical secretion of mucus, the so-called “cervical plug,” is increased.

The diminished resistance to touch and the increasing width of the tissues seemingly shorten the cervix. These changes, while beginning in the first month, are not recognizable until the second month; from this time they are progressive.

Erroneous views as to changes in the cervix uteri during pregnancy existed in years past. It was believed that the cervical canal was greatly shortened to form part of the corporeal cavity, and that toward the last of pregnancy no cervical cavity existed, it having lost one-half its length by the sixth month, and so on, until it was obliterated in the eighth and ninth months. These views, long entertained, were in 1826 called in question by Stolz, whose views most modern obstetricians now uphold. Post-mortem examinations made of women in advanced pregnancy—the best proofs—have established the fact that the cervix maintains its length of 2.5 centimeters (1 inch) or more to the last days of pregnancy (Fig. 137).

Digital exploration through the patulous cervix substantiates this fact. But during the fortnight preceding parturition a genuine broadening of the cer-

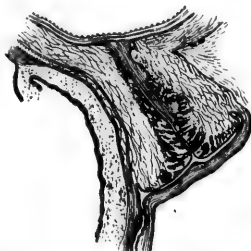


FIG. 137.—Cervix at end of pregnancy (Winter).

vix takes place, when the cervical canal is merged into the upper uterine cavity—a result, no doubt, of the incipient uterine contractions preparatory to labor, as pointed out by Matthews Duncan.

The broadening of the cervix in the last stage of pregnancy, prior to eight and one-half months, then, is, seemingly, not real until the last fortnight. More or less of these changes remain even after parturition; in other words, the cervix does not completely resume its pristine virgin firmness and smoothness of surface or its original size.

While these changes are noticeable from pathological as well as from physiological causes, their value in the diagnosis of pregnancy is only to be relied upon, when associated with other signs and when taken in conjunction with certain other symptoms.

(b) *The Violet Color of the Vulvar and Vaginal Mucous Membrane.*—Dr. Jacquemin of Paris first discovered this sign, and Dr. Chadwick of Boston has fully dwelt upon its diagnostic significance. Inspection reveals its presence. It is of importance in the earlier months of pregnancy, when there is seen the then pale violet color, becoming more bluish as pregnancy advances. But this sign is not of positive value. While arising from a venous stagnation in the vaginal vessels, it may come also from vaginal or uterine congestion due to disease. This sign is valuable often as early as the second month, and in the latter half of pregnancy it is highly diagnostic; then its recognition possesses great value.

(c) *Hegar's sign*, which has been given to the profession within the last decade, possesses a great advantage.



FIG. 138.—Pregnant uterus of early part of third month (Braun's frozen section), with probable post-mortem retroversion: D, D, decidua vera.

In all doubtful conditions of early pregnancy this sign ought to be searched for. It is to be detected by vaginal touch and by bimanual examination. Its presence implies a change in the consistency of the lower uterine segment. The greatest changes in the uterus must and do take place in the body of this organ—the bed, as it were, for the growing ovum. The neck of the womb is less supplied with blood, and it receives comparatively little of the stimulus of pregnancy. The development of the cervix is largely completed by the fourth month. During the first six or eight weeks of gestation the body of the uterus enlarges, especially in its antero-posterior diameter.

Bimanual, recto-vaginal, or abdomino-vaginal touch will detect some enlargement in all directions—anterior, posterior, and lateral. The lower uterine segment becomes soft, compressible, and pulsating; above there is the projecting or bulging uterine wall, hard and

resisting during uterine contraction, boggy or soft during relaxation. The accompanying illustrations (Figs. 138-140) best elucidates these facts. The uterus in shape has been likened to that of a demijohn, to an old-fashioned fat-bellied jug, or to a sphere (corpus) resting upon a cylinder (cervix). These alterations in consistency, while noticed on the posterior wall by rectal touch, are best detected along the anterior uterine wall, by the finger in the vagina with

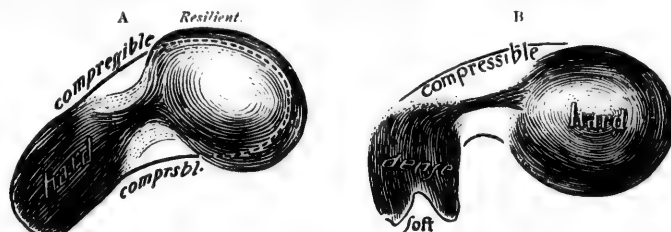


FIG. 139.—Bimanual signs of the sixth to eighth week, showing diagrammatically the alterations in consistency of cervix and corpus uteri: A represents the vaulting or overhanging of the body and its elastic feel, with the compressibility of the lower uterine segment and the unyielding cervix; B shows the conditions during uterine contraction, when the body is hard and globular.

the outer hand on the abdomen seizing the uterus. The structures of the corporeal wall may become soft and yielding, and may show a contrast with the cervix below. It is true that the sign of *bogginess* of the body is not always present, and that its presence is simulated somewhat by morbid states, but the peculiar compressibility of the lower segment, together with the bogginess of the body and the changes in shape of the womb, is not simulated by anything else.

(d) *Changed Position of the Uterus.*—We must not fail to bear in mind the modification in the positions of the uterus that pregnancy usually produces.

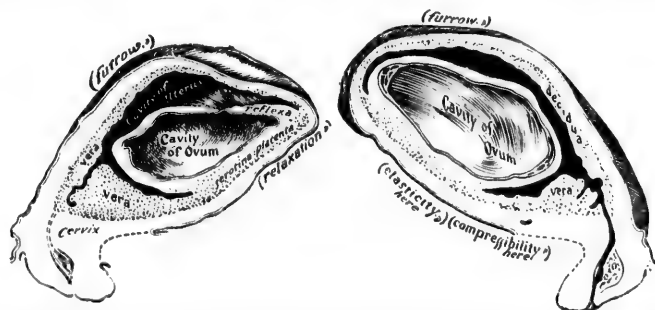


FIG. 140.—Frozen section of uterus at two and a half months (Pinard), showing relaxed and thin walls, thickened decidua; with the clinical findings of Figure 139 it will be seen how the bimanual signs originated.

In the first and second months the uterus is somewhat lower, but in the third month it undergoes an increased anteversion, for the reason that the relatively increasing weight of the body of the uterus with its growing contents tilts the upper end of the uterine lever downward and forward. This change in position will be noticed in all cases except those in which pregnancy has occurred in a previously retroverted uterus; the retroversion is then increased.

This statement is made, notwithstanding that some of this anteversion may be apparent, not real, the antero-posterior diameter of the organ being thickened.

Hegar's sign, recognized, as it may be, so early as the second month, and the overhanging and softness of the corpus, the changed position of the uterus, and the violet color of the vagina and cervix uteri, while not absolutely positive signs, are highly probable evidences when associated with some of the rational symptoms referred to. They possess a diagnostic significance ever to be watched for and carefully estimated. They are a complexus of physical signs that gives a reasonable diagnostic certainty.

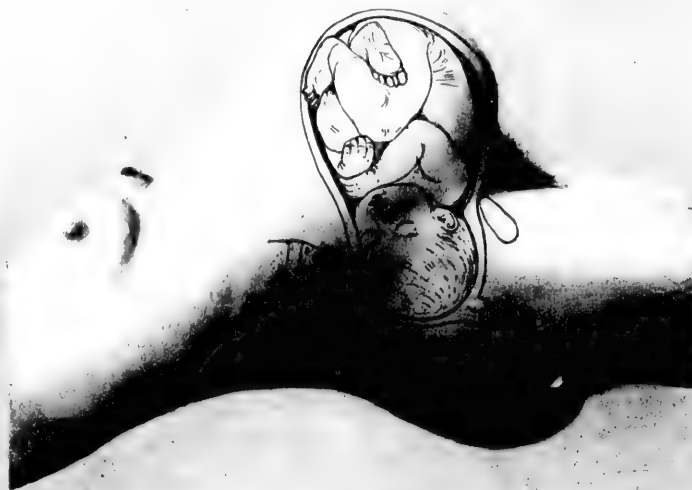
6. Abdominal Changes.—Under this head are included all those changes in size, shape, and appearance of the abdomen that may take place.

(a) *Enlargement, Size, and Shape of the Abdomen.*—At first, during the first six to eight weeks, there is somewhat of a flattening of the abdominal surface, due, doubtless to the descent of the uterus into the pelvic cavity, thus slightly dragging the bladder downward and making traction on the urachus, thereby drawing the umbilicus inward. The navel in consequence becomes depressed; hence the common expression, "A blank before a bank." Later in the fourth month, as the growing uterus rises for proper accommodation in the abdominal cavity, a slight abdominal enlargement will be observed, and the umbilicus is no longer sunken. By the fourth month the fundus uteri has risen about 5 centimeters (2 inches) above the symphysis pubis. The vertical enlargement progresses at the rate of fully two fingers' breadth each four weeks, reaching the umbilicus at the end of the sixth month, and touching the ensiform cartilage at the end of thirty-eight weeks, or eight and a half lunar months (Pl. 19, Fig. 1). The umbilicus for many weeks prior to that time has been protruding. During the last two weeks of utero-gestation the upper portion of the abdominal walls protrudes less and the girth of the woman seems smaller (Pl. 19, Fig. 2). The patient feels more comfortable. The cervical canal is now effaced, the child *in utero* has sunken, and the pelvic ligaments are relaxed—changes preparatory to the coming parturition. During this time it will be noticed that the enlarging pregnant womb is symmetrical, smooth in its contour, larger vertically than transversely, and by proper palpation it will be felt to contract spontaneously.

(b) *Coloration.*—On inspection of the abdomen of pregnant women there will be recognized not only the condition of the navel, but also a changed color of the abdominal surface, and the presence of striæ, due to distention of the abdomen. The pigmentation may extend from the pubis to the xiphoid cartilage—the brown lines. On the sides of the abdominal walls and down the thighs red, blue, or white markings, like cicatrices, may be seen.

(c) *Fetal Movements.*—Fetal movements are generally visible after the sixth month through the abdominal parietes.

7. Ballottement.—Ballottement is a passive motion of the fetus, consisting of the peculiar sensation felt by the examining fingers upon giving the fetus a motion *in utero*. Vaginal ballottement is usually employed, although abdominal ballottement is also practicable at times, and may be noticed for a



2. Abdominal enlargement of the uterus at different weeks of gestation. 2. Abdominal enlargement of the sixth month of pregnancy.



1. Abdominal enlargement of the sixth month of pregnancy, showing position of the fundus of the uterus at different weeks of gestation. 1. Abdominal enlargement of the sixth month of pregnancy.



longer period of time, even during the beginning of labor. For the ballottement impulse to be perceptible there must be a mobile fetus, not too large, and a sufficient quantity of the liquor amnii to permit the entire fetal displacement *in utero*. The woman stands or reclines during its performance. In the vaginal ballottement the finger is placed within the vagina, anterior to the cervix, the pulp of the finger being applied to the anterior vaginæ fornix by a direct brisk motion. The fetus is propelled upward into the uterine cavity, and, falling back by its gravity, an impulse is imparted to the finger against which it falls.

Ballottement distinctly noticed is a pathognomonic sign of pregnancy, there being no other condition in which a solid body is found floating in the uterine cavity. The absence of this body does not preclude the possibility of pregnancy, for different conditions may prevent its being noticed, such as excessive or great diminution in size of the fetus, hydramnios, multiple pregnancy, some abnormal presentation, or a faulty insertion of the placenta.

Vaginal ballottement can sometimes be practised successfully as early as the latter part of the fourth month. It is more easily recognized in the fifth month, is most distinct in the sixth, continues in the seventh, is doubtful in the eighth, and is absent in the ninth month.

8. Intermittent Contractions.—As soon as the uterus is developed sufficiently to be felt by the hand through the abdominal wall, there may be perceptible intermittent uterine contractions which are constantly going on at intervals of a few minutes throughout pregnancy. Purely independent of volition, they may become valuable, in a diagnostic sense, in corroborating other signs. Uterine contractions are not positive signs, because the uterus undergoes somewhat similar contractions to free itself of clots of blood, of polypoid or fibroid tumors, and of retained secundines, or they may be simulated by a distended bladder.

The method of procedure for detecting uterine contractions is to grasp the fundus uteri for from five to twenty minutes, with the patient recumbent on her back, the uterus meanwhile being lifted by the right finger *per vaginam*, the abdominal walls being relaxed by some flexion of the lower limbs. The characteristic hardening will then be felt, the contraction lasting for several minutes. To Braxton Hicks we are indebted for the thorough elucidation of this sign, which is often referred to as "Braxton Hicks' sign of pregnancy."

9. Quickening and Fetal Movements.—Quickening is the sensation experienced by the mother as the result of active fetal movements. The period when these active movements are felt is quite uncertain. Usually quickening is considered to occur about the middle of pregnancy, consequently the time of expected parturition is based on this event, but very unreliably. Certain sensations of motion, such as fluttering or pulsating, are sometimes felt by the mother earlier than these active motions. As pregnancy advances these active motions increase in frequency and become more marked, and toward the last they are seen very generally. When felt or seen by the physician, as can be done after the sixth month, fetal movements constitute a very valuable and

positively reliable sign not only of pregnancy, but also of a live child *in utero*. This sign should never be inferred to exist from the statements of the patient. Supposed fetal movements are frequently felt by the patient, and are thought to be, but are not, evidences of pregnancy; frequently they are only illusory. These seemingly fetal motions come from the abdominal walls in false pregnancy or from the intestines in tympanites.

Failure to detect fetal movements does not negative pregnancy, for the child may be dead or its motion may not be felt. To detect these movements, place the patient on her back upon a table or a bed, with the thighs flexed and the abdominal walls relaxed. All clothing should be removed from the abdomen. By palpation and renewed pressure at different parts of the abdomen the active fetal movements may be detected; better, sometimes, by applying the hands to the abdomen, after first wetting them with cold water to excite a reflex action of the fetus.

10. Uterine Souffle.—This murmur has been called "placental," because it was thought to be due to the movement of the blood through the placental sinuses; it has also been named the "abdominal souffle," because it was thought to result from the pressure of the gravid uterus on the abdominal vessels. Neither of these two theories is correct. This placental murmur is doubtless due to the movement of the maternal blood through the uterine blood-vessels; hence it should be called "uterine souffle." Heard first in the fourth month, on the sides of the upper part of the uterus, especially the left side, which for obvious reasons is brought nearer the anterior abdominal wall, the murmur is at all times synchronous with the maternal pulsation. It is very uncertain as to its presence, tone, pitch, duration, and location; if once heard, it soon leaves, to return at another time or at another place. It is thus usually heard irregularly as to time, place, pitch, and duration until the end of pregnancy. Uterine souffle is no longer regarded as a certain proof of pregnancy. A sound exactly resembling it is not unfrequently heard in interstitial fibroids of the uterus, and it may be heard when ovarian tumors are present. In the majority of cases of parturition it is heard for the first two or three days in the lying-in state.

11. Fetal Heart-sounds.—These sounds are a comparatively modern discovery. Mayer of Genoa first heard them in 1818, in examining the abdomen of a pregnant woman. The fetal heart-sound cannot, as a rule, be heard earlier than the fifth month in utero-gestation. A practised ear may sometimes detect it a few weeks earlier, as in the fourth month. As this sound becomes stronger and louder in advancing pregnancy, its detection in the last few months becomes very easy. The sound may, of course, be quite feeble. If normally vigorous, some non-conducting material, as a tumor, may intervene, impeding its transmission, or there may be a posterior position of the child, thus making it less distinct; hence the inability to hear the fetal heart-sound ought not to negative a pregnancy. When attempts are made for its detection, the room should be quiet and the patient should be in the dorsal posture, with the head on a pillow and the thighs flexed lightly to

the body or extended. The stethoscope ought to be utilized, from motives of modesty, in localizing the sound of the fetal heart. This instrument should be applied to the abdomen below a transverse line passing through the umbilicus, because the head of the fetus is more often lower than the breech. Since the occiput in most instances points toward the left side of the maternal pelvis, the fetal heart-sound is most frequently heard with greatest distinctness upon the left lower space of the abdomen (space D, Fig. 141). If not heard in

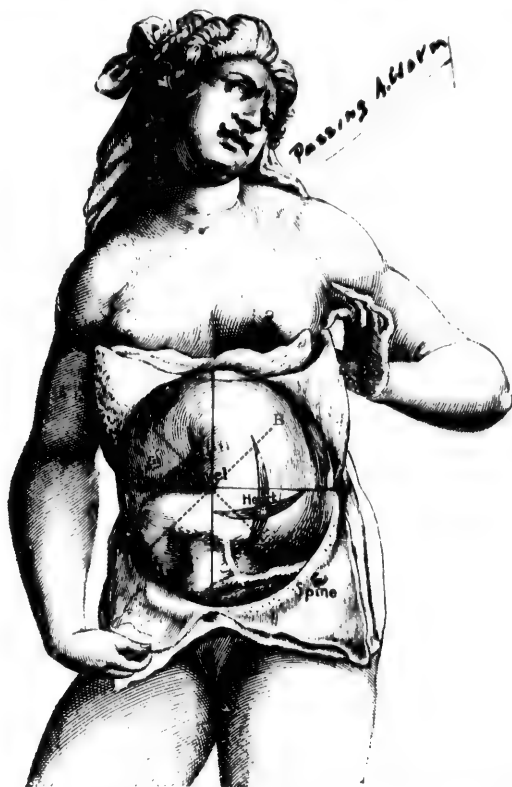


FIG. 141.—Location and intensity of fetal heart-sounds in the left occipito-anterior position (the four quadrants are indicated by the red lines; the pose is from Spigelius).

this space, search for it should be made over other spaces (as B, C, A). If heard well in regions C, D, the inference is that the head is the lowest part of the fetus, and that the back of the fetus is anterior; if heard best in regions A, B, it is to be inferred that there is a pelvic presentation.

The mean frequency of the pulsations of the fetal heart is about from 135 to 140 to the minute; they are less frequent in large than in small children, and probably are less frequent in males than in females. A temporary variation in their frequency and force is very common. The sound is double and

rhythmic, the first sound being more clear and distinct than the second; then comes a brief pause, when the second sound is heard; a longer pause follows before the double rhythmic sound is again heard. The above-mentioned frequency indicates that there is no relation of the fetal heart-sound to the pulsations of the mother's heart. These two sounds are perfectly independent.

Because of the varying frequency of the fetal heart-sounds, attempts have been made to base some reliable predictions as to the sex of the fetus *in utero*; but experience has proven that but little reliance can be placed on such attempts.

The sound of a fetal heart well heard when the uterus is relatively small—too small to accommodate a fetus of five or more months' development—should at once create suspicions of an extra-uterine pregnancy.

As auscultation with the stethoscope reveals the presence of the uterine souffle and the fetal heart-sound, the practised ear may also detect the *funic* or *umbilical souffle*—an intermittent hissing sound synchronous with the fetal heart. It is referable to the umbilical cord. It is heard in but the smallest number of cases, and its causation is conjectural. As a sign of pregnancy it has very little value.

There are also heard sounds produced by active movements of the fetus *in utero*. Fetal movements, for instance, may be heard by the ear instead of being felt by the hand. Their value is significant.

12. Fetal Contour.—Inspection of the shape of the abdomen in pregnancy is also valuable; a careful, well-trained touch by palpation may detect the size, shape, and presentation and position of the fetus, as well as, at times, the presence of twins *in utero*.

13. Mental and Emotional Phenomena.—Pregnancy quite generally modifies the nature—physical, mental, and emotional—of a woman. At times, she is more vigorous, buoyant, and cheerful than in the non-pregnant state. More generally, however, she is more or less irritable, excitable, and fretful. As the physical appetites for food in quantity, quality, and variety are frequently changed, so also is the moral sense sometimes seriously deranged.

Classification of the Phenomena of Utero-gestation.—The symptoms and signs of pregnancy may now, for convenient study, be classified as to the time of their occurrence. For instance, the nine calendar months of utero-gestation may be divided into three periods, and a classification may be made of the aforesaid phenomena as to these three periods.

First Period of Utero-gestation.—This period comprises the first three calendar months—the time during which the gravid uterus is enclosed within the true pelvic cavity. The *symptoms* are—(1) Menstrual suppression; (2) gastric disorders; (3) mammary changes; (4) vesical irritation. The *signs* are—(1) Beginning patulousness of the os uteri; (2) softening of the infra-vaginal cervix, gradually extending higher; (3) uterus slightly lowered during the first and second months, and anteverted in the third month; (4) flattening of the abdomen, with increasing depression of the umbilicus, the depression gradually disappearing toward the fourth month; (5) violet-colored vaginal

walls and cervix uteri; (6) Hegar's sign (compressibility of lower uterine segment), with softened and rounded uterine body.

Second Period of Utero-gestation.—This period embraces the fourth, fifth, and sixth months. The *signs* and *symptoms* are—(1) Menses still absent; (2) subsidence of the gastric disturbances; (3) increasing and progressive development of the mammary signs; (4) vesical irritation improved; (5) the uterus higher, ascending into the abdominal cavity; (6) cervix higher in vagina; navel no longer depressed; (7) fundus uteri two fingers' breadth above pubes at the end of the fourth month; at the umbilicus toward the end of the sixth month; (8) cervix more softened and patulous; (9) fetal active motion (quickening) experienced toward the end of the fourth or in the fifth month; (10) ballottement detected, becoming more distinct; (11) intermittent contractions also detected, increasing in force; (12) uterine souffle audible in the fourth or fifth month; (13) fetal heart-sounds easily detected, usually first in the fifth month.

Third Period of Utero-gestation.—This period embraces the seventh, eighth, and ninth months. The *signs* and *symptoms* are—(1) Menses continue absent; (2) gastric symptoms slight or only occasional; (3) further progressive development of the mammary signs, colostrum sometimes present; (4) uterus continues to rise in the abdominal cavity, reaching midway between the navel and the ensiform cartilage at the end of the seventh month; reaching the ensiform cartilage in the first two weeks of the ninth month; after which period it gradually becomes lower; (5) ballottement continues until the eighth month, when it is doubtful; it is absent in the ninth month; (6) umbilicus commencing progressively to protrude; (7) vaginal cervix seemingly shortened, more thickened, softened, and patulous, getting higher; (8) fetal movements felt or seen after the sixth month; (9) in last two weeks the fundus uteri, having reached its maximum height and size, begins to descend, when the cervix undergoes a real shortening. Now the cervical lips become thinner. The presenting part of the fetus, having partially entered the pelvic inlet, is more easily detected by vaginal touch. Pressure-symptoms of the chest and the stomach disappear, though edema of the limbs and the genitals may show themselves.

Relative Value of the Symptoms and Signs of Pregnancy in Point of Diagnosis.—Very properly we may classify all the symptoms and signs of pregnancy as medical evidence of the presumptive, the probable, and the positive kind. They naturally rank in value inversely in the order named.

The presumptive evidences of pregnancy are—(1) Menstrual suppression; (2) morning sickness; (3) irritable bladder; (4) mental and emotional phenomena.

The probable evidences are—(1) Mammary changes; (2) the bimanual signs; (3) abdominal changes in size, shape, and color; (4) changes in cervix uteri in size, shape, consistency, and color; (5) uterine murmur; (6) intermittent contractions.

The positive signs are—(1) Active movements of the fetus; (2) passive movements of the fetus (ballottement); (3) fetal heart-sounds.

Differential Diagnosis of Pregnancy.—Nothing can be of greater

moment, on the one hand, than a correct diagnosis of pregnancy, and on the other of the many conditions simulating pregnancy. Not only does a correct estimate of the actual condition concern the patient and her family in a physical, mental, or moral sense, but the professional reputation of the physician is also seriously involved. The legal and social relations of some pregnancies possess a deep and painful interest; therefore let no opinion be expressed in any case until a reasonable certainty can be arrived at. Time may be needed to clear up all doubts.

As pregnancy implies a certain variable amount of abdominal enlargement after the fourth month, its existence must necessarily be differentiated from the many other conditions, physiological and morbid, that are attended with the same sign. In the differential diagnosis not much difficulty need exist after this enlargement is fairly well advanced. Most mistakes are doubtless made when the gravid uterus is still within the pelvis; there is then often much doubt. There will first be considered the differential diagnosis of pregnancy and the morbid conditions simulating it during the first three months. Just here comes into play the diagnostic value of the sign so forcibly elucidated by Hegar. The peculiar shape of the uterus in the second and third months of pregnancy (see p. 164) is not simulated by anything else. While in a measure resembling subinvolution of the uterus, it is to be remembered that in this morbid condition there is an organic enlargement uniform in all directions. In chronic metritis attended with hyperemia, with or without flexion, the uterus is not jug-shaped, and the elasticity and compressibility of its uterine walls are absent. Chronic metritis attended with parenchymatous hyperplasia of the uterine body, shows the uterine walls dense, hard, sensitive to touch, not elastic, doughy, or boggy. An interstitial fibroid in either uterine wall is dense, hard, and uneven. Doubt is apt to pertain to cases of pregnancy associated with chronic retroversion, but then a careful analysis of the presumptive symptoms will always be helpful in differentiation. A clear study of the physical signs of the cervix and the corpus uteri as to color, size, shape, and consistency are of inestimable value in the first three months. A search for Hegar's and the other bimanual signs ought never to be neglected. Pregnancy may be concealed, feigned, and imagined. These possibilities must be considered and be cleared up.

When pregnancy has created material abdominal enlargement, the diagnosis ought to be differentiated from all other conditions attended by the same sign, such as ascites, ovarian tumor, uterine fibroid, distended bladder, tympanites, pseudo-eyesis (false pregnancy), enlarged uterus from gas (physometra) or from water (hydrometra), retained menses (hematometra), obesity, enlarged abdominal viscera, malignant disease, etc. In differentiating these conditions the three positive signs of pregnancy should always be borne in mind.

In ascites fluctuation is most distinct; the resonant note on percussion is always changed in location according to the position of the patient. Cardiac, hepatic, or renal disease can usually be detected as a causative factor of the ascites, and the symptoms of pregnancy are absent.

In ovarian tumor a fluctuation of the abdomen is also present, though less distinct; the abdominal enlargement has come on more slowly and has a peculiar shape. Menstruation is ordinarily present, and the signs—intrapelvic and abdominal—of pregnancy are entirely absent. The area of dulness and tympanites is not essentially altered by posture. As pregnancy and an ovarian tumor quite often coexist, a constant watch ought to be made for this possibility in every case of an abdominal enlargement. The presence of two tumors of different consistency with an intervening sulcus is quite significant; when both are present, the uterus itself by a vaginal examination shows enlargement, and there are present the presumptive symptoms of pregnancy, while there are also the signs of an ovarian cyst.

A uterine fibroid creates an abdominal enlargement which is more firm, hard, and dense than any of the above-mentioned conditions; it is nodular and very often asymmetrical, is quite slow of growth, and menstruation is not only present, but, as a rule, is also increased in quantity and lengthened in duration. While the uterine murmur may be very well marked, there are present no positive signs of pregnancy.

A distended bladder is of comparatively short duration, is attended with much discomfort, is associated with dribbling of the urine, and is quickly relieved by the use of a catheter.

Fecal accumulation is dissipated by a copious rectal enema and free catharsis.

Tympanitic distention of the abdomen is always very resonant on percussion, is variable in size on different days, does not fluctuate, and quickly disappears by proper treatment.

Pseudo-cyesis, or false pregnancy, occurs oftenest toward the menopause, and its false appearances are quickly unmasked by the administration of an anesthetic.

Obesity shows the abdominal walls soft, doughy, and easily palpated between the fingers of either hand, and there are no intrapelvic signs indicative of pregnancy.

Hydrometra and physometra are extremely rare. There is always with them an absence of most of the probable and all the positive signs of pregnancy. The uterus in both diseases enlarges more slowly, and never to the extent of an advanced pregnancy.

Diagnosis of Extra-uterine Pregnancy.—A judicious differential diagnosis of intra-uterine pregnancy implies a careful consideration of the possible or probable existence of extra-uterine pregnancy. This is especially the fact when the gravid uterus or the extra-uterine sac is still within the true pelvis, for if the diagnosis is the best guide for treatment, now is the time of all others to know the exact condition of affairs. The following symptoms and signs are worthy of most reliance from a diagnostic point of view. When extra-uterine pregnancy exists, there are—

1. The general and reflex symptoms of pregnancy; they have often come on after an uncertain period of sterility. Nausea and vomiting appear aggravated (Winkel).

2. Then comes a disordered menstruation, especially metrorrhagia, accompanied with gushes of blood, and with pelvic pain coincident with the above symptoms of pregnancy. Pains are often very severe, with marked tenderness within the pelvis. Such symptoms are highly suggestive.

3. There is the presence of a pelvic tumor characterized as a tense cyst, sensitive to touch, actively pulsating. This tumor has a steady and progressive growth. In the first two months it has the size of a pigeon's egg; in the third month it has the size of a hen's egg; in the fourth month it has the size of two fists.

4. The os uteri is patulous; the uterus is displaced, but is slightly enlarged and empty.

5. Symptoms No. 2 may be absent until the end of the third month, when suddenly they become severe, with spasmodic pains, followed by the general symptoms of collapse.

6. Expulsion of the decidua, in part or in whole.

Numbers 1 and 2 are *presumptive* symptoms of extra-uterine pregnancy; Numbers 3 and 4 are *probable* signs of extra-uterine pregnancy; Numbers 5 and 6 are *positive* signs of extra-uterine pregnancy.

Some of the above-mentioned symptoms resemble those of early abortions. In all cases with the history of a supposed abortion, when an intrapelvic mass is then or afterward felt, there should be suspicion of an extra-uterine pregnancy. In consideration of the possibility or probability of extra-uterine pregnancy, based on the detection of a lateral extra-uterine sac, we are necessarily obliged also to exclude in the differentiation a small ovarian tumor, an enlarged ovary, a hydrosalpinx or a pyosalpinx, and pelvic exudates (cellular or peritoneal). A distinct sulcus between the sac or the tumor and the uterus may be a physical sign to guide in the diagnosis. The symptoms of a severe and overwhelming pain are quite generally manifested by the end of the third month, because most cases are tubal in some form. These symptoms are not noticed when the extra-uterine pregnancy is entirely abdominal. The possibility of mistakes in diagnosis is to be considered with reference to—(a) Retroflexion of the gravid uterus; (b) pyosalpinx with amenorrhea, or causing abortion; (c) malignant tumors of the abdomen with ascites; (d) normal pregnancy complicated with abdominal tumors; (e) coincident intra- and extra-uterine pregnancy; (f) pregnancy in a deformed uterus.

Diagnosis of Multiple Pregnancy.—Suspicion of a twin pregnancy are rarely excited; but the presence of multiple pregnancy may be conjectured from the following data: (a) Very large size of the abdomen; (b) exaggeration of the results of a gravid uterus; (c) irregularity of abdominal enlargement; (d) detection by palpation of the abdominal walls of two fetal heads and other parts of fetuses; (e) ballottement imperfect or impossible; (f) fetal movements distinctively felt in different parts of the abdomen; (g) recognition by auscultation of two fetal heart-sounds, not synchronous with each other and heard at different locations, with an intervening space where the heart-sounds are heard feebly or not at all.

Diagnosis of a Prior Pregnancy.—In the earlier months the diagnosis of any previous pregnancy must always be obscure, even if search has been made for evidences of a previous pregnancy within a few days after the expulsion of the uterine contents. Of course we would expect to find the uterus more or less enlarged, some local hyperemia of it, the os uteri patulous, and there may be present some lochial discharge. But these distinctive differences between the uterus which has suffered an early abortion within the first three or four months and the chronically-enlarged uterus menstruating are not sufficient to be surely reliable. In case of death a post-mortem examination would probably throw much light on the question of gestation. In an aborted uterus some remains of the placenta or of the decidua might be detected, the placental site would be imperfectly involuted, and in the ovaries the corpus luteum of pregnancy might be found.

The physical evidences of a previous pregnancy are most distinctly marked when parturition has occurred late during pregnancy or at term. The uterus by palpation in the hypogastric region is then felt much larger; the lochial discharge is more characteristic; a fatty degeneration can be detected in the uterine walls; the placental site will be well marked; the vagina is patulous and relaxed; the corpus luteum of pregnancy is quite distinct. Should the cervix uteri or the perineum have been lacerated in the previous parturition, they will be observed either ununited or secondarily healed. The vulvar fourchette is always destroyed after the first delivery. Very often—quite generally, indeed—unmistakable proof of a previous pregnancy and delivery is noticed by vaginal touch. An inspection of the cervix uteri shows that the os is oval, with imperfectly-healed rents. A careful examination after death will show the same condition, and the cervical canal will be found less fusiform; the uterus is enlarged and heavier, the corporeal cavity having lost its clearly-defined triangular shape, the fundus uteri being no longer convex, as in a nullipara, but flat or concave.

All general appearances of recent deliveries are very uncertain; there are none which may not be produced by other conditions. Some women look perfectly well after a delivery, and one unacquainted with the clinical history would never suspect that parturition had occurred. Inspection of the abdomen is more to be depended on. A soft and relaxed abdominal wall, with the skin thrown into folds, traversed by white shining lines (*lineæ albicantes*) extending from the groin to the navel, is strong probable proof of recent delivery. The breasts after the first few days are fuller, are tumid, and they contain the lacteal secretion. The presence of colostrum-corpuseles bespeaks a recent delivery. The nipples show the characteristic areolæ.

Chloasma uterinum usually occurs on the face of pregnant women, and lasts for many years. But the same skin affection is also met with in single women, and even in men. It is due to physiological and pathological changes in the uterus and to various disorders of the menstrual functions.

Diagnosis of the Life or the Death of the Fetus.—The fetus may from some cause, maternal or fetal, die *in utero* before its time of viability. Such

a death generally shows itself sooner or later by certain maternal symptoms. The patient has a feeling of languor and physical depression, with impaired appetite; there will be noticed a furred tongue, nausea, vomiting, and a pale and sallow color of the patient. Chilliness with some fever is sometimes observed. The abdomen does not progressively enlarge; the breasts become flaccid and diminished in size; and a fetid discharge from the vagina, containing exfoliated epidermis, is a certain but not common indication. The absence of the fetal heart-sounds, especially if once heard, and the cessation of active motion of the child, once felt, if pregnancy has advanced beyond the sixth month, are positive proofs. Should the fetal head have presented, its scalp becomes soft and flabby; the cranial bones are loose and movable, overlapping one another. The lips of the fetal mouth in face presentations become flabby and motionless. No caput succedaneum can form in delivery, for there is no fetal circulation to assist in its production. Large quantities of meconium may be discharged, although the breech does not present. Should the breech present, the examining finger discovers that the anal sphincter of the fetus will not spontaneously contract. The umbilical cord, prolapsing in shoulder or other presentations, is cold, flaccid, and pulseless, contrary to its warm, full, and pulsating condition during fetal life.

The rapidity of maternal infection from retention within the uterus of a dead fetus will depend upon her vital resistance, the condition of her general health, and—the most important factor—whether or not the membranes have been ruptured and atmospheric air has entered the uterine cavity.

2. DURATION OF PREGNANCY.

Parturition or childbirth means the end of pregnancy. The end of pregnancy, or the time of expected labor, is always important to foretell, not only for the physician's but also for the patient's sake. Cazeaux has given expression to the statement that conception is more apt to follow when a voluptuous sensation or a general erethism occurs during or following coitus; but this cannot be true. Many women are always passive in coitus, and all women are entirely passive in conception.

The normal duration of pregnancy is nine calendar months or about ten lunar months. To be more exact, its duration is between two hundred and seventy and two hundred and eighty days, from the first day of the last occurring menstrual period, or about two hundred and seventy-five days, calculated from its cessation. Various methods have been suggested to obtain the time of the expected parturition; the most reliable of these methods is as follows: Determine the exact day at which the last menstruation appeared. Count forward nine months, or, better, count backward three months, and then add seven days. Irrespective of the time of the year from which this count is begun, a very close approximation, from two hundred and seventy-eight to two hundred and eighty days, is obtained. This is the rule; but it is uncertain and exceptions are not uncommon. Many difficulties are experienced in determining the date of the expected parturition. As most pregnancies

occur in married women, we cannot base any calculations on a single act of coitus. Even if there has been but one coitus, all physiologists admit that there is a variable period in different women, and in the same woman at different times, between insemination and the fertilization of the ovum.

When the impossibility of ascertaining the precise time of fertilization and the probable variation in the length of gestation itself are considered, the reasons for this uncertainty become apparent. Recognizing with His that the moment of fecundation marks the beginning of pregnancy, the possibility of fixing this occurrence becomes of great interest. The uncertainty becomes still greater owing to our inadequate knowledge as to the length of time during which the sexual elements, the ova and the spermatozoa, retain their vitality after liberation from their respective sources.

While the exact time during which the matured but unfertilized ovum retains its power of successfully receiving the male element is unknown, the observations conducted on lower animals render it probable that the ovum is capable of impregnation at any time during its sojourn within the oviduct and before reaching the uterus, or, probably, for a period of about one week from its escape from the Graafian follicle.

The remarkable vitality of the spermatozoa even under far less favorable conditions—direct observation showing that these elements retain their movements for over nine days outside the body—renders it almost certain that their powers of fertilization are maintained for a long time after they are deposited within the healthy female generative tract; the assumption of His, Hausmann, and others that the spermatozoa are capable of fertilization after their sojourn of three or more weeks within the oviduct is well founded.

Consideration of these facts renders apparent the impossibility of fixing with certainty the beginning of pregnancy, since conception may result from the union of the ovum liberated at the commencement of menstruation with the spermatozoa introduced toward the end of the period; or it may result, as pointed out by His, from the meeting of the male elements already within the oviduct with an ovum discharged a day or two before the occurrence of the menstrual phenomena. The possible discrepancies arising from these causes have been represented graphically by Marshall as follows:

I., 2, 3, 4, 5, 6, 7 26, 27, 28, II.

in which I. is the first day of the last actually occurring menstrual period, and II. is the first day of the first *omitted* period. Should pregnancy, however, occur under the conditions regarded as possible by His—that is, by the fertilization of an ovum precociously discharged just prior to the first omitted period, a discrepancy of over three weeks would appear between the actual termination of pregnancy and the estimated date of labor, when calculated in the usual manner from the first day of the last occurring menstruation. The general consensus of opinion, however, regards the time immediately following the menstrual period as that most favorable for fertilization, the upper third of the oviduct being probably the locality where fecundation most usually takes place.

Should impregnation have occurred following the menstrual period, the

next expected period will almost certainly be absent; but if it has taken place within a few days before an expected period, the expected flow may not physiologically be suspended, but simply be diminished in quantity or be shortened in duration. The prediction of the date of labor from the last menstruation is likewise very unreliable in all women in whom its previous occurrences have been irregular or uncertain in time.

Quickening, as a rule, is noticed by the female in the fourth month—about four and one-half months—and it is not unusual for counts to be made from this period. But as quickening (active movements of the child) is felt at uncertain times, this rule has been found to be very fallacious. At a certain time it proves to be the most reliable of any rule for adoption—namely, when menstruation has physiologically been suspended by an intercurrent lactation. Then there is no last menstrual period to count from, and we have but to add four and one-half months to this time of quickening to determine the approximate time of the expected labor.

It is no wonder that the duration of pregnancy in the human female has been such a fruitful topic for discussion among obstetricians. Not only the moral character of a woman, but also the legitimacy and the hereditary rights of a child, may depend upon a fair solution of this question. Is it possible for a woman to give birth to a child ten, eleven, or twelve months after the death or the continued absence of her husband? is a medico-legal question concerning which the obstetrician may be called upon to express an opinion. Experience with some of the lower animals in whom the date of a single coitus is well fixed, and the records made by numerous distinguished obstetric authorities, make such exceptional instances as reliably creditable. Most of such offspring are very large male children.

3. PROLONGATION OF PREGNANCY.

Sir Charles Clark in 1816, when giving his evidence in the famous Gardner-Peerage case before the House of Commons, said: "I have never yet seen a single instance in which the laws of nature have been changed, believing the law of nature to be that parturition should take place forty weeks after conception." Many physicians of the present day hold that the law of nature is quite fixed in this respect—that human pregnancy never exceeds this term. But we have now sufficient evidence to show that human pregnancy is not so definitely and precisely fixed as some think. The duration of pregnancy may be shorter or longer than 280 days.

To what extent may pregnancy be prolonged, and what are the evidences of its prolongation? It is easy to understand the moral and legal aspects of this important question. The moral character of the female, and the inherited status and legitimacy of an offspring may depend on a fair and just fixation of its paternity, and on the determination of the possibility of the prolongation of human pregnancy, as when a woman gives birth to a child ten, eleven, or twelve months after the death, or the forced absence, of the husband. Laws on this question vary in different countries. In France legitimacy cannot be

contested until 300 days have elapsed since the death of the husband, and in Austria and Prussia about the same time is allowed. In England and in the United States no time is fixed.

Numerous cases are on record of a prolongation of pregnancy to 336, 332, 324, and 319 days, respectively, after the last menstruation. Granting that conception in these cases did not take place within a few days after the last menstruation, as is the rule, but was postponed to just before the first missed period of that function, we can subtract about 23 days from these periods of gestation, and will then have 313, 309, 301, and 296 days, each exceeding the ordinary duration of pregnancy.

Admitting that the first menstrual cessation was due to some abnormal cause—a mere possibility—we will still have a prolonged duration of pregnancy. Hence the possibility of a variation of a conception being uncertain as to time does not account for the great variation in gestation so often observed. It is extremely uncommon in healthy young women for a menstrual period to be skipped for one time only without there being some noticeable change in the bodily health.

Variations in the duration of pregnancy occur in cows, in which there have been careful records of a single coitus. When impregnation occurs in the human female as the result of a single coitus, the date of which is accurately recorded, as among single women or among married women whose husbands have been absent for months, possible errors of the date of conception may be avoided. If, then, pregnancy is at times prolonged, to what extent is there any protraction? Meigs, Atlee, and Simpson have mentioned instances when the duration was prolonged to almost or quite a year. Dewees records a case which was prolonged to ten calendar months. Playfair, Lusk, and Leishman mentioned cases of considerable prolongation. Taylor and Beck in their work on Medical Jurisprudence record numerous instances of protracted gestation.

Other physiological functions of life, such as dentition, puberty, or menstruation, may vary as to the time of occurrence. Some women appear to go uniformly beyond the usual time for parturition. The degree of uterine activity must be less with them. More frequently the sex of the forthcoming delayed child is male rather than female. We are forced, then, to the conclusion, by a study of the analogy of other functions of the body, by observations in the lower animals, and by accurate reliable data, from women in particular, to believe that pregnancy may be, and often is, prolonged. Gestation may be lengthened, parturition may be delayed, from a few days to several months.

The causes which conduce to labor—the maturing of the decidua vera, its preparatory disintegration, and the final detachment of the membrane of the ovum from the uterine lining—do not always occur at the same time or with the same degree of activity; hence gestation may be prolonged.

III. HYGIENE AND MANAGEMENT OF PREGNANCY.

Hygiene of Pregnancy.—To be carried safely through the period of utero-gestation, the most critical time of her life, physiologically speaking, the pregnant woman needs special care. Particular attention is to be given her in the selection of diet, exercise, rest, sleep, clothing, and bathing. Her mental condition is to be watched; her attention diverted. The condition of the breasts calls for some prophylactic treatment.

Diet.—Very early in pregnancy the desire for food is diminished and certain unusual articles of food may be craved. Fair quantities of food are always needed. Respect must be paid to her morbid longings in taste. Thus the time, place, and social association in partaking of food, and its kind and variety, are always to be considered. The morning sickness is thus sometimes best abated. In the fourth month the gastric irritability usually spontaneously subsides, the appetite reappears, and the digestion improves. All foods, animal and vegetable, that are reasonably well digested and nutritious are best suited to her condition. In a word, the diet of a pregnant woman should be plain, simple, easy of digestion, highly nutritious, and partaken of at regular intervals. A good general supply of nitrogenous food, with vegetables and fruits, is called for. No inflexible rules can be made for all cases. As some foods do not agree equally well with all patients, personal likes and idiosyncrasies must be consulted. A generous diet improves hematosis, increases functional activity, augments body-weight and body-heat, imparts tone and firmness to the blood-vessels and tissues, and diminishes the susceptibility of the nervous system to pain and reflex irritation. That the diet must directly influence the growth and development of the fetus *in utero* is reasonably clear.

In the latter part of pregnancy the gravid uterus has risen to and presses upon the stomach, hence food has to be taken in greater moderation and at shorter intervals. A milk diet is at times especially needed. Albuminuria is a condition calling for the use of milk, as recommended by Tarnier. Its absolute use, strictly enforced, gives very good results in this complication.

Exercise.—Moderate exercise can almost always be well borne. Violent exercise and excessive fatigue are invariably to be avoided. Extraordinary exercise, such as riding horseback or over rough roads, dancing, or lifting heavy weights, is injurious. Long journeys by water or by land should be postponed if possible.

Is parturition made more easy by unusual physical exercise? Affirmatory opinions have been entertained. Doubtless, women whose habits have accustomed them to considerable physical exercise can, all things being equal, undergo parturition easily and quickly; but those unaccustomed to any special physical exercise should undertake only what can comfortably be borne. If active exercise is not well borne, then passive exercise may be highly beneficial. Riding in the open air gives the pregnant woman the necessary fresh air and sunlight. Crowded and ill-ventilated rooms are to be avoided.

While moderate exercise is needed in many or in most cases, its continuance is objectionable in cases where the normal relaxation of the pelvic joints becomes excessive. The pubic joints, most often affected, are so relaxed at times that locomotion is impeded and rest is demanded.

Rest.—A pregnant woman needs abundance of sleep, because of its health-giving, restoring influence. A portion of each day, after the mid-day meal, may well be selected for the assumption of the recumbent posture, to obtain for an hour or two either rest or sleep.

Clothing.—Great care is to be taken that the clothing is so adjusted as not to compress the abdomen and the chest. While the quantity and the quality of the clothing are to be determined by the season of the year, the garments placed around the waist are to be as light as practicable consistent with comfort. The clothing is best suspended from the shoulders. The corset and tight-fitting skirts are injurious, impeding as they do the expansion of the growing uterus and its contents, and favoring the development of symptoms of a not uncommon complication of pregnancy—albuminuria with uremia. Multiparæ with relaxed abdominal walls often experience comfort by giving support to these parts with an abdominal bandage, thereby maintaining the uterus in a more normal position, wherein there is better accommodation of the fetus. All possible pressure of the pelvic and renal veins is to be removed.

Bathing is to be administered to the body at the usual intervals observed in health—daily in warm weather, and at least twice a week in cold weather. The baths are to be general, with an abundance of water and soap. The temperature of the bath may be either warm or cool, according to previous habits and to the season of the year. The functional activity of the skin, quite often impeded in the last weeks of pregnancy, should be maintained carefully by the free use of the bath.

Vaginal injections are not required if there is no leucorrhea, vaginal or uterine. If an injection is given because of this complication, there is nothing better than a saturated solution (one quart) of boric acid given with a fountain syringe in a very gentle current.

Sexual intercourse is to be regulated carefully, for very often it is found to be injurious to pregnant women. While especially enjoyed by some pregnant women, coitus is distasteful to most women at this period, and it becomes the source of much pelvic discomfort to not a few; it may create an abortion. Even uncivilized nations have condemned the privilege of sexual intercourse during the period of pregnancy, and have visited punishment on the offender. During the first few months of pregnancy, when so many abortions occur, and toward the last of pregnancy, it is best for the husband and wife to occupy separate beds.

May *local treatment* to the diseased cervix and canal be carried on during pregnancy? With proper precautions and due care, this question is answered in the affirmative. Most of the accidents causing the induction of abortion by local interference have arisen from a neglect to investigate and determine the condition of the body of the uterus, and to ascertain whether it may

have been gravid. Pregnancy aggravates chronic cervical endometritis in that it increases the cervical catarrh, the granular degeneration, the secondary vaginitis, and the vulvar pruritus. By the gentle use of warm vaginal injections of a uniform temperature, and by the topical use of astringents and emollients, and in rarer cases of the nitrate of silver in solution, not only may the patient be made more comfortable, through an improvement in the local condition and the arrest of reflex disorders, such as nausea and vomiting, but parturition itself may also be made easier.

The mental condition of pregnancy is always important to consider. Emotional susceptibility is usually somewhat increased. The pregnant woman, quite excitable and irritable, readily responds to external influences by which, in the non-gravid condition, she would not be influenced. Sometimes she feels unusually well, is intellectually brightened and more active, takes greater interest in her household affairs, and says she is positively happier. At other times a certain despondency creeps over her mental state; she is unusually morose; there is observed irritable moodishness or peevishness beyond the control of the will; the senses of sight, hearing, smell, and taste, and the sensory or motor nerves, are frequently perverted without any structural changes in the nerves concerned. All these perversions or exaltations of function are doubtless directly or indirectly attributable to the quantitative and qualitative changes of the blood from pregnancy, and to the physical changes going on in the sexual organs, creating reflex disorders. Structural alterations in the growing fetus may be effected, modified, or perverted by psychical influences. Certain fetal disorders may result from maternal impressions. Monstrosities do at times so occur.

Physiologists admit, and observations prove, that the maternal emotions do affect the development of the exterior of the fetus. Likewise may the mental development be altered in its complex and delicate organization. Idiocy may so result. The mind influences and modifies the body in ways unexplained.

In view of these facts the wise physician should aim to direct the mental condition of his patient. While all sudden unpleasant news, frights, and physical shocks are carefully to be avoided, those circumstances which improperly harass the pregnant woman are to be dismissed. Kind assurances are ever helpful. A judicious amount of amusement is not to be forgotten. The mind is to be occupied pleasantly, and diverted into new, pleasing, surprising channels, into associations agreeable and cheerful. Around the patient should be thrown a gentle, protective care, and she should ever be treated with considerate kindness. It becomes the duty of the husband to give his wife an intelligent co-operation to bear her burden.

Management of Pregnancy.—It becomes the duty of every practitioner of medicine engaged to attend a woman in an expected parturition not only to give her some general hygienic directions as to diet, dress, exercise, and the regulation of her bowels and skin, but also in a general way he should assume some professional care of her throughout her pregnancy. Many disorders and

complications are apt to arise during this period, and much depends upon prompt and well-directed advice in their judicious management.

First of all, the stomach disorder most frequently occurring calls for some attention. Reference has been made to its dietetic management, more efficacious, it may be, than the medicinal. In this connection the writer has realized general good results from the administration for a time of koumiss. Failing with the retention of the food on the stomach, rectal administration of food is next to be utilized. For the physiological nausea and vomiting of pregnancy the writer has found the following remedies efficient: Tincture of *nux vomica*, weak solutions of atropia, sodium bromid, cocain, and electricity. Faradization (secondary current) of the stomach and the dorsal spine, and galvanization of the central sympathetic are worthy of a more extended use for this affection than they have yet received.

Next, the alvine evacuations are to be maintained daily. A good diet and regularity of habits show their good results. The mineral waters, such as Congress, Hathorn, the sulpho-saline waters, or a solution of phosphate of sodium or Carlsbad salts or the Seidlitz powders, are indicated. Purgation is seldom called for. The best laxative remedies are aloecin, podophyllin, and cascara sagrada.

Above all, it is important that careful attention be given to the renal function. Once a month at least, during the latter half of pregnancy, should the physical, chemical, and microscopical elements of the urine be ascertained, to detect any possible alterations in its quantity and quality. Not a few cases of puerperal eclampsia from uremia may thus be averted or be modified by a supervision of the kidney excretion. "To be forewarned is to be forearmed" was never better illustrated than just here. Albuminuria is present in at least from 5 to 10 per cent. of the cases of pregnant women; some claim that the proportion is larger.

A careful examination of the abdomen may very properly be made after fetal viability. The external examination by palpation, together with an internal vaginal examination, is called for in all cases toward the last two weeks of pregnancy, to determine not only the fetal viability and a possible multiple pregnancy, but also to ascertain the presentation and position of the fetus *in utero*, the existence of any complications, as hydramnion, and to appreciate the cervical condition in shape, size, and patulousness, in order more correctly to estimate the time of the approach of the expected parturition. The pelvis of every woman should be examined by external and internal pelvimetry in the seventh or eighth month of pregnancy, if in her first pregnancy or if she has had any special difficulty in a previous parturition. At the time of this examination directions may be given as to the preparation of the room, the bed, the garments, and as to obtaining all needed articles.

The exact methods of diagnosis that prevail in maternity hospitals ought also to exist in private practice. If the labor promises to be long, difficult, or very painful from obstructions of any kind, the obstetrician ought to know it in advance, that he may elect at a proper time before parturition whether to choose

the induction of a premature labor, to depend on the use of the forceps, or to resort to a podalic version, a symphysiotomy, or a Cesarean section. How many craniotomies could thus be avoided and maternal deaths prevented!

The mammary glands need ample room for their development to prepare them for the coming function of lactation. The nipples, especially if retracted, should always be drawn out by the application of the index finger and the thumb for a few minutes each day during the last six weeks of pregnancy. Exposure of the glands and the nipples to the air doubtless tends to diminish their tendency to become sore and fissured. Daily ablutions with cold water are always essential. A topical application of the following as a prophylactic remedy for sore and fissured nipples is to be recommended when it is thought desirable to use an astringent application:

R. Tannin,	ʒj ;
Glycerinæ,	ʒss ;
Aquæ rosæ,	ʒss.—M.

Sig. Apply daily as directed.

As no two pregnant women are alike, and as no two pregnancies in the same woman are alike, no absolute rule can be framed for all. The expectant treatment is largely called for. Discretionary powers are necessarily given the physician in charge. Only general principles can be laid down for guidance. Special directions are called for when there are special disorders and complications. A very frequent danger is that an abortion or a premature delivery may be precipitated by uterine contractions. Any constitutional disease, especially syphilis, may require special medication. Doubtless there are remedies which often favor uterine tonicity and become prophylactic against abortions. *Viburnum prunifolium*, *aletris*, and *cimicifuga* doubtless favor the normal completion of gestation. In all cases as little medicine as possible ought to be given. Pregnancy is a purely physiological condition, and it is best managed by an observance of the hygienic instructions.

IV. THE PATHOLOGY OF PREGNANCY.*

I. DISEASES OF THE SEVERAL SYSTEMS.

THE remarkable changes occurring in the genital organs of woman, and also throughout her entire body, as gestation advances, occasion conditions which often transcend the bounds of health and become states of disease. As these changes are most pronounced in the uterus and its appendages, it will be appropriate to consider, first, the pathological conditions of the uterus and its appendages induced or exaggerated by the pregnant state. It will then be proper to study those general derangements which the condition of pregnancy invites; next in order, to treat of the influence of the various infectious agents upon the pregnant organism; and finally, the surgical injuries and processes observed during this period.

1. PATHOLOGICAL CONDITIONS OF THE UTERUS AND APPENDAGES.

The Uterus during Pregnancy.—While the position of the pregnant uterus is subject to frequent change, it has been found by Ferguson¹ and others to be rotated to the right in 80 to 90 per cent. of all pregnant women. Great distention of the bladder may temporarily lessen the degree of rotation upon its axis. Occasionally this dextro-torsion becomes excessive, as in a case reported by Wenning,² in which the uterus at six months' pregnancy was so strongly rotated toward the right as to simulate extra-uterine pregnancy upon that side. The left tube was greatly enlarged.

The term "hypertrophy" best describes the normal condition of the pregnant uterus in the various phases of gestation: its peritoneal covering, its interlacing muscular and elastic tissues, and its glandular lining membrane, all become enlarged by production of new elements from nuclei already existing. The enormous increase in area and in blood-supply is especially remarkable in the pregnant woman: although the deciduous membranes represent the greatest development of its epithelial elements, still the endometrium shares extensively in the general hypertrophy. It is readily seen that this condition of plethora naturally favors the rapid development of any neoplasm previously existing in the uterus, especially any neoplasm whose elements closely resemble normal uterine structures; such neoplasms are—

Myomata of the uterus, sometimes termed fibro-myomata or uterine fibroids. As has been shown by Croom³ and others, although myomata exist frequently among childbearing women, they do not always attract attention during pregnancy, and are often undetected at labor. Such tumors grow,

* The *superior* figures (1) occurring throughout the text of this article refer to the bibliography given in the Reference List on page 313.

however, with great rapidity during pregnancy, often interfering with the circulation in the lower extremities. Many cases in which early pregnancy is complicated by edema of the legs, and in which abortion occurs at four or five months, accompanied by profuse hemorrhage, are cases of fibroids complicating pregnancy: their bulk causes interference with the functions of the bladder and the rectum, while they alter the position of the uterus, causing abnormal presentations of the fetus and prolapse of the cord at labor. Their encroachment upon the uterine muscle interferes with its normal contraction and retraction; hence the rhythmic contractions of the uterus commonly existing during pregnancy are unusually painful, and sometimes are excessive in strength. The substance of the uterus may be so altered that rupture of this organ may occur, as in a case described by Hogan,⁴ where a fibroid pregnant uterus ruptured spontaneously at about the fourth month of gestation. When rupture does not take place, spontaneous reduction of a displaced fibroid uterus sometimes results from the stimulus to growth and intermittent contractions furnished by pregnancy. Spontaneous reduction is frequently followed by rupture of the membranes and abortion, as pointed out by Loviot.⁵ Although fibroid tumors of the uterus are often supposed to prevent conception, cases are on record where sterility persisting for some years in such patients had been replaced by pregnancy so late as forty-five years of age.⁶ Pregnancy exerts a remarkable influence upon fibroid tumors of the uterus, not only in causing their rapid growth, but also in frequently bringing about a condition of well-marked softening and fatty degeneration: this pathological condition sometimes decides the choice of a method of treatment in these cases.

The treatment of pregnancy complicated by fibroid tumors when interference is necessary is by operative procedure. Submucous tumors, if they become pedunculated and distend the lower uterine segment, frequently present before the fetal head, and, exciting premature labor, may be removed by the obstetrician in advance of the child. Intramural tumors require no treatment during pregnancy unless the results of their pressure upon important viscera oblige the obstetrician to perform hysterectomy. Subserous fibroids in the pregnant patient may often be removed without terminating the pregnancy, as in cases reported by Frommel⁷ and others. Should extensive fibro-cystic changes in the uterus occur, complicating pregnancy, this condition should not be allowed to go on to term, but hysterectomy should promptly be performed.

Routier⁸ reports a successful myomectomy during pregnancy, and he has collected, with his own, 15 cases in which the operation was performed, ten of which recovered. Strauch⁹ also reports the successful removal of a fibroid as large as a goose-egg from a pregnant uterus by abdominal section. Phillips¹⁰ gathered reports of 282 cases of fibroids complicating pregnancy: his statistics indicate a high mortality from radical procedures. Pozzi,¹¹ from his collection of these cases and his personal experience with them, considers simple myomectomy the preferable procedure in suitable cases.

The occurrence of spontaneous abortion sometimes necessitates immediate operation in cases of pregnancy complicated by fibroid tumors; thus Bourcart¹²

reports the case of a pregnant patient whose gestation was complicated by myoma of the uterus and by excessive torsion of the uterus and its appendages. Spontaneous abortion was followed by chill and fever. Taking advantage of a fall in the temperature, Bourcart performed hysterectomy. The result was successful. Attention has recently been called by Hofmeier¹³ to the influence which myomata exert upon pregnancy in causing abortion. He cites from the records of others 796 cases of pregnancy with this complication, and finds that abortion occurred in 6.9 per cent. of the cases. He naturally concludes that the majority of patients who suffer from myomata during pregnancy pass through gestation but slightly influenced by the tumor of the uterus.

Ott reports a case of pregnancy nearly at term complicated by fibromyoma of the uterus and bronchitis.¹⁴ Amputation of the uterus was performed; the stump was covered with peritoneum and dropped. The patient and her child made a good recovery.

Gordon¹⁵ reports a successful myomectomy by which a fibroid was removed from the anterior wall of the pregnant uterus: although the uterine wall was left thin and vascular, hemorrhage was controlled by stitching the peritoneum and the base of the wound with fine catgut. Recovery was rapid and pregnancy was uninterrupted.

Staveley¹⁶ collected a considerable number of cases of fibroid tumors complicating pregnancy, and he adds from the records of the Johns Hopkins Hospital two cases in which myomectomy was performed successfully during pregnancy without interrupting gestation. Staveley's tables embrace 33 cases with a maternal mortality of 24.25 per cent. Statistics show that in late years myomectomy for this condition is more successful than before antiseptic surgery attained its present perfection in technique. During the last eight years the mortality-rate of myomectomy in these cases has fallen to 11.75 per cent.*

Cancer of the uterus, complicating pregnancy, increases in cases of carcinoma with great rapidity during the pregnant state, and with even greater vigor during the puerperal condition. When pregnancy has not advanced beyond the fourth month, Van der Veer¹⁷ and others practise vaginal extirpation of the uterus. In cases where carcinoma attacks the cervix the prognosis is most unfavorable. If delay is practised, the tissues surrounding the cervix soon become infiltrated, and delivery by abdominal section, should life persist to full term of pregnancy, is the only alternative. The fact that carcinoma grows with greatest rapidity during the puerperal condition obliges the obstetrician, whenever possible, to perform complete extirpation of the uterus, either at the time when the fetus is delivered or as soon as possible thereafter. The danger of septic infection following Cesarean section is so great that the majority of operators prefer hysterectomy or total extirpation.

Cancer occasionally involves the uterine tissue so extensively as to result in rupture of the uterus. This extensive involvement occurs in cases where preg-

* The literature of this subject given on page 313 will interest those who desire to pursue it further.

nancy supervenes upon the existence of the cancerous condition. The great stimulus which pregnancy causes in malignant growths results in the rapid dissemination of malignant tissues, which gradually destroy the elasticity and the resisting power of the muscular layers of the womb. Rupture occurs in these cases during abortion or during labor at term. The prognosis is exceedingly grave, for, even should the patient rally immediately from the rupture, the malignant growth must sooner or later end her life.

Auvard reports the case of a patient in her eleventh pregnancy who had uterine cancer for two years.¹⁸ Labor was exceedingly slow, the pains being very weak but persistent. When partial dilatation was present the os was incised in several directions and the fetus was found in breech presentation. Extraction by the feet was performed, and persistent hemorrhage ensued; on examination the uterus was found ruptured transversely at the upper edge of the lower uterine segment. The patient succumbed to shock.

Cancerous infiltration of the tissues of the cervix often necessitates multiple incisions in any necessary manipulation during pregnancy or at labor. Von Herff¹⁹ illustrates the value of free incisions in cancerous cases. Cesarean section had been decided upon, but, as a last resort, multiple incisions were freely made, and they proved efficacious. Early pregnancy complicated by uterine cancer invariably demands total extirpation, from which even unfavorable cases recover and the operation has prolonged life, as illustrated by Möller.²⁰ In his patient the cancerous uterus was extirpated with great difficulty by reason of the infiltration of surrounding tissue. A rent was left in the peritoneal cavity, through which rent a loop of intestine protruded. Notwithstanding these unfavorable features, the patient made a good recovery, and some time after the operation was comparatively free from cancer. Sutugin reports two cases of amputation of the uterus at term for cancer, in each of which cases the life of the child was saved. Taylor of Japan records²¹ a very unfavorable case of cancer in which vaginal extirpation was performed with great difficulty. A favorable result followed.

In cases where the cervix only is involved the diseased tissue should at once be removed by the knife and cauterization, with the hope that the progress of the disorder may be checked temporarily while the pregnancy advances, thus affording the child a better opportunity for life. In carcinoma of the pregnant uterus complete extirpation is the only treatment that promises a favorable result. If the patient is seen for the first time in pregnancy advanced beyond the fourth month, delay may be advised in the interest of the child so long as the tissues about the uterus do not become involved. Under the improved methods now followed in performing total extirpation the prognosis for the mother is no longer desperate, a fair chance for recovery from the operation and the prolongation of life being thus given her.²²

In **epithelioma of the cervix** complicating pregnancy, Edis²³ reports a case in which an epitheliomatous mass was found involving nearly the whole cervix and extending down upon the posterior vaginal wall, rendering the passage of the fetal head impossible. The child was delivered by Cesarean section.

tion, and seven months after the operation the epithelioma had made but little progress.

The decidual lining of the uterus may occasionally become the seat of malignant disease, as observed by Sänger and Chiari.²⁴ This form of cancer is described by these writers as a true sarcoma of the decidua: its symptoms are foul discharge and hemorrhage persisting after labor, and its fatal termination usually occurs within six or seven months after delivery. Metastatic deposits are not uncommon, the cells of which bear the characteristics of decidual cells. There is an innocuous form of this growth, also described by Sänger,²⁵ that is not to be mistaken for decidua remaining adherent after a former pregnancy.

Hypertrophy of the decidua occurring during pregnancy may be non-malignant and not dependent upon the existence of syphilis; thus, Hermann²⁶ describes cases of decidual hypertrophy in which the tissue measured one-fiftieth of an inch in thickness: microscopic examination revealed the presence of large cells, with large nuclei, five or six in number, without intercellular substance, but infiltrated and containing leucocytes. A similar condition has also been described by Virchow,²⁷ Strassman,²⁸ Dohrn,²⁹ Gusserow,³⁰ Klebs,³¹ and Matthews Duncan.³²

Spontaneous rupture of the uterus occasionally happens during pregnancy. Such cases are usually found to have been complicated by a fibroid tumor or by displacement of the uterus, with adhesions binding it in its displaced position. Manipulation intended to replace the uterus has sometimes hastened its rupture; thus in a case reported by Dickey³³ the patient was in the third month of her fifth pregnancy: an effort had been made to replace a retroverted womb, the effort causing the patient considerable distress. A few days afterward something was felt to give way, and the patient perished in a few hours from shock. Post-mortem examination showed early pregnancy and the uterus ruptured transversely from one Fallopian tube to the other.

Spontaneous rupture of the uterus may result from the rapid development of a large fetus in a uterus whose tissues have been weakened by previous disease. The fetus may escape into the abdominal cavity, as illustrated in a case reported by Madurowicz,³⁴ in which fatty degeneration of the uterine wall at the junction of the fundus and cervix was found. The fetus had become partially encapsulated. Purulent peritonitis ensued, and the abdominal wall opened spontaneously with the discharge of pus. The patient died of exhaustion.

Endometritis during pregnancy results from an aggravation of a pre-existing inflammatory condition, and it is a familiar and frequent cause of early abortion. In patients who complete the period of gestation the existence of this condition may be suspected when occasional discharges of blood or of watery mucus occur. While the pregnancy is not likely to go to term, still its continuance must not be despaired of because of these discharges. An endometritis set up or aggravated by pregnancy not infrequently causes adherence of the membranes about the cervix and the lower uterine segment, often com-

plicating labor by premature rupture of the bag of waters and protracted dilatation of the birth-canal. It is noticed in women who conceive shortly after an abortion that an endometritis arising at the abortion may persist throughout pregnancy, becoming aggravated, and resulting finally in the firm adherence of the placenta and in complicated labor; thus, Löhlein³⁵ reports a case of this character in which the pregnancy went to term, its latter portion being complicated by intermittent pyrexia and by a very firmly adherent placenta.

The treatment of this condition is entirely in the interest of the mother, as the prospect of her retaining the ovum to maturity is so slight that exhausting hemorrhage or febrile disturbance should lead to the prompt emptying of the uterus: this should only be done in the most thorough surgical manner and under strict antiseptic precautions. Sufficient dilatation to permit the use of the sharp curette and of drainage should be secured by using the fingers or solid metal dilators. Should septic infection and fever be present, the blunt-edged douche-curette may be employed to great advantage, thoroughly emptying the uterus under a stream of antiseptic fluid. Where sepsis and fever are absent the sharp curette followed by antiseptic irrigation will be found efficient. Drainage with iodoform gauze, with repeated intra-uterine irrigation, is indicated, should fever and foul discharge continue. Curetting is best performed at the time of abortion or premature labor, or, if this opportunity is omitted, it should be done when the patient has recovered strength and the interior of the uterus has ceased to furnish a foul discharge.

Salpingitis existing during pregnancy complicates the pregnant condition largely by reason of the adhesions and the inflammatory exudates usually present with the salpingitis. As the uterus increases in size, tension upon these adhesions causes very considerable pain, and if the adhesions are firm, binding down the uterus, abortion is not infrequently the final result. A frequent cause of retroversion and retroflexion of the gravid uterus is to be found in salpingitis and in the adhesions and exudates which accompany this condition; in such cases obstinate nausea and vomiting, and finally abortion, may be the direct consequence of the salpingitis present.^{36 37} Salpingitis is by no means a trifling complication of pregnancy, as cases are recorded in which acute sepsis, with general peritonitis developing twenty-four hours after labor, has caused death. It is certainly true that a patient suffering from salpingitis should avoid pregnancy, and should subject herself to prompt and thorough treatment if the liability to pregnancy exists.

Diseased conditions of the ovary complicating pregnancy are usually made worse by the gravid condition; thus, ovarian cysts, solid tumors of these organs, and inflammatory conditions are greatly aggravated during pregnancy. Acute oöphoritis complicating pregnancy is of rare occurrence, and it may result from an exacerbation of a chronic process or septic infection from a previous abortion. Three cases of this affection are reported by Coe;³⁸ in each of two cases tubal and ovarian abscess formed and was emptied. All three patients recovered, although convalescence was prolonged. The treat-

ment of this condition is largely expectant, abdominal section being most successful before the fifth month of pregnancy.

Thomson³⁹ has shown that while the tubes undergo a marked hypertrophy during pregnancy, the ovary itself does not. The alterations observed in the ovaries during pregnancy are caused by foreign growths, and not by the increase of elements normally present. In addition to the danger of abortion which the size of an ovarian tumor occasions, there is possible risk that such a tumor may twist its pedicle, and that gangrene may be added to the complications of labor in this condition. It has repeatedly been shown that the operation of ovariectomy is safe and satisfactory during pregnancy, and this fact calls for the removal of ovarian tumors as soon as their presence is detected. In these cases adhesions are not often present, nor does the pregnant condition predispose to their formation.

The rapid development of a cystic condition of the ovary may completely mask an early pregnancy, as in a case reported by Polaillon,⁴⁰ in which pregnancy could not positively be diagnosticated until a cystic ovary and an adherent tube were removed. This operation did not interfere with the pregnant condition, the patient going to term and being delivered of a healthy child.

Spontaneous cure of a pelvic cyst complicating pregnancy occasionally happens in the case of broad-ligament cysts, which disappear by spontaneous rupture. Ruge⁴¹ describes a case four months pregnant in which under anesthesia a pelvic cyst was pushed up above the brim of the pelvis, relieving pressure upon the uterus. Abortion followed, and after recovery the abdomen was opened; no cyst was found, and its disappearance is ascribed to spontaneous rupture. The evidence in favor of the operative treatment of ovarian cysts complicating pregnancy is greatly in the ascendant over any other form of treatment; this is shown by the results of Schroeder and Olshausen, Flaischlen⁴² and Dsirne;⁴³ the mortality of the operation ranges from 9.8 per cent. to 5.9 per cent.

Mangiagalli⁴⁴ and Acconci⁴⁵ similarly report good results from ovariectomy during pregnancy.

Terrillon⁴⁶ advises against puncture of ovarian cysts during pregnancy, and urges ovariectomy not earlier than the third nor later than the fifth month.

Disorders of the vulva may occur during pregnancy as the result of mechanical injury or be associated with some constitutional condition. Hematoma of the vulva is especially likely to happen by reason of the congested condition of the parts caused by pregnancy. An illustrative case is reported by Ehrendorfer;⁴⁷ incision under antiseptic precautions and tamponing, preferably with iodoform gauze, resulted in speedy cure. Pruritus of the vulva is one of the most annoying complications of the pregnant condition. In cases where there is no reason to suspect the neglect of cleanliness, pruritus is to be considered as due to one of two classes of causes. The first class comprises the many diseases which alter profoundly the condition of the skin; chief among these are disorders of the digestive and excretory systems, as diabetes

and nephritis. The treatment of the pruritus in such cases resolves itself, first, into the treatment of the general condition, and then into such local applications as may be found of use. The latter embraces the various antiseptics and anesthetics which are available in the practice of dermatology. The second class is those cases in which no diseased condition of the general organism can be found to account for the pruritus, and in which the disorder is purely local. This class is treated by local applications, and in obstinate cases resection of the diseased tissues may prove the only alternative. Snger⁴⁸ has shown that in these cases partial or total extirpation of the vulva is thoroughly legitimate, and should include the removal of the glans clitoridis. Where the entire vulva is affected plastic operation may be necessary to cover surfaces exposed in the extirpation. In circumscribed pruritus of the vulva it may be possible to limit the extirpation to the affected part.

Elephantiasis of the labia may complicate pregnancy, and prove an annoyance to the obstetrician at the time of labor. The appended illustration (Fig. 142) is taken from a case under the observation of, and described by, the writer. The patient, who was pregnant for the first time, gave no history of venereal disease; the growth persisted for several months before the occurrence of pregnancy, and increased slowly during gestation. Aside from its bulk it occasioned no suffering. During labor it rendered thorough vaginal examinations difficult, and at the moment of delivery impeded somewhat the dilatation of the birth-canal. Especial precautions were taken to maintain the parts in an antiseptic condition at the moment of delivery. The patient's convales-



FIG. 142.—Elephantiasis of the labia (one-fourth life size).

cence was uninterrupted, as no serious wound of the hypertrophied tissue occurred during the labor. During the puerperal period the injured tissue decreased very slightly in size.

The presence of bacteria in the genital tract of the healthy pregnant patient is an interesting question which has occasioned extensive research. The results go to show that pathogenic bacteria are not present in the healthy pregnant patient. Among the most thorough of such investigations are those of Winter,⁴⁹ made at the suggestion of Schroeder: he found that the Fallopian tubes contained normally no micro-organisms: this is also true of the normal uterine cavity. In half the uteri examined germs were present at the internal os; in the secretion of the cervix, and also in the vagina, there were found abundant micro-organisms. These germs were found to be pathogenic, but not possessing the virulence which characterizes them when observed amid tissues in a pathological condition. It was found, however, that when pathogenic organisms were introduced from without the germs already present in the genital canal assumed a virulent character.

Diseased conditions of the vagina occasionally complicate the pregnant condition; thus, Rissman⁵⁰ reports a case in which a polypoid degeneration of the connective tissue of the vaginal wall attained such proportions as to prolapse before the fetal head during labor and to offer an obstacle to delivery; in this case the condition was accompanied by gonorrheal infection.

Vesico-vaginal fistula caused by pressure in a previous labor may become a serious complication at labor, by reason of the thickened condition of the tissues about the fistula and the excessive pain which pressure occasions.⁵¹

Displacements of the pregnant uterus are not infrequent, often causing great discomfort, and sometimes seriously complicating and even terminating pregnancy. If the patient has already borne children, the supports of the uterus are frequently so weakened that when repeated pregnancy ensues displacement readily occurs.

The most frequent uterine displacement complicating pregnancy is retroversion of the gravid uterus: this produces the usual symptoms, pain and dragging sensation in the back, interference with the functions of the rectum and often of the bladder, and a sensation of weight and heaviness relieved only by the recumbent position upon the side or the assumption of the knee-chest position. On vaginal examination the os and cervix are found directed upward and forward, and the fundus of the uterus is below the promontory of the sacrum. In uncomplicated cases, where no peritoneal adhesions exist binding down the uterus, retroversion of the pregnant womb is a comparatively simple matter. As the uterus increases in size the womb gradually rises in the pelvis, until at four or five months it passes above the brim and remains permanently in the abdominal cavity.

The treatment of uncomplicated retroversion of the pregnant uterus consists in supporting the womb by tampons of antiseptic wool smeared with an antiseptic ointment. A preparation containing 10 grains of powdered boracic acid to the $\frac{1}{2}$ ounce each of lanolin and vaselin is most useful in these cases. Once in four or five days such a tampon should be removed and the vagina be irrigated gently with warm water or with a saturated solution of boracic acid. A Sims speculum should then be used, and the pelvic floor

be drawn downward and backward, when a tampon of antiseptic wool, rolled into a shape fitting the pelvic floor, should be introduced and carried across from side to side, putting the utero-sacral ligaments slightly upon the stretch and raising the fundus of the uterus. Such tampons have the great advantage over the hard-rubber pessary that they create no irritation, support the uterus comfortably, and mould themselves perfectly to the contour of the parts. Their use, however, requires discrimination in fitting the tampon properly, and calls for regular supervision of the physician at comparatively frequent intervals. Cases are occasionally met with in which it is impossible for the patient to have the services of a physician except at intervals of several weeks: it is then often advantageous to fit a carefully-moulded hard-rubber pessary which shall raise the uterus to its proper level. It is often asserted that such a pessary may cause abortion: the fact, however, remains that it is not a well-fitting pessary that produces abortion, but it is the displacement of the uterus resulting from a lack of such support as the pessary should give. Cases of habitual abortion caused by displacement of the womb are not infrequently cured by raising the pregnant womb.

Many cases of retroversion of the uterus are associated with chronic pelvic peritonitis, and are complicated by prolapse of one or both of the Fallopian tubes and of the ovaries, and the presence of adhesions binding the displaced organs in their artificial situation. With these patients the pain as the uterus increases in size is very distressing, and results from traction upon adhesions which occasionally yield, greatly adding to the patient's comfort. In other cases the separation of these peritoneal adhesions is accompanied by very considerable shock, which simulates to some extent the shock of rupture of the sac in tubal ectopic gestation. In still other cases these adhesions are so firm and tense that spontaneous separation of them is impossible, the womb remaining fixed in the position it occupied at the time of the original peritoneal inflammation. The continued growth of the uterus may so stretch these adhesions as to enable the womb to rise into the abdominal cavity. Should the peritoneal surfaces not yield, however, a retroverted and incarcerated uterus will be the result, and, as the fetus increases in size, the adhesions not yielding, abortion is inevitable; and should fresh septic infection occur and the patient survive, her condition will be aggravated by fresh adhesions, and chronic invalidism will result.

The frequency of this complication may be estimated by the report of Martin,⁵² who found in 24,000 women 121 cases of retroversion and retroflexion of the uterus persisting during pregnancy. In 27 of these cases the deformity was congenital, and one case is cited in which a patient suffered for three and a half years with congenital retroflexion and with gonorrhea, but conceived after recovery from the gonorrhea. Sterility in cases of congenital retroflexion depends upon a diseased endometrium or diseased condition of the tube, and not upon the congenital deformity. In 94 of the cases the retroversion persisted after repeated pregnancies. Nine of these patients wore pessaries at the time when conception occurred. The most significant

symptom which drew the patient's attention to the backward displacement of the uterus, and for which she sought medical aid, was dysuria. When spontaneous restitution fails no time should be lost in accomplishing the same by instrumental means. That retroflexion and incarceration of the pregnant uterus is a serious condition may be inferred from the report and collection by Treub of 50 cases of death from this cause.⁵³ He found that out of the 50 deaths, thirteen were from uremia, eleven from rupture of the bladder (Fig. 143), six from sepsis; ten followed peritonitis and cystitis; three were caused by pyemia, two by rupture of the peritoneum, and five cases followed accidents occurring during an effort to replace the uterus.

These statistics have recently been amplified by Gottschalk,⁵⁴ who collected 67 deaths from backward displacement of the pregnant uterus, the immediate causes of which he describes as follows: Uremia and collapse, sixteen cases; septicemia arising from the bladder, four; gangrene of the bladder, three; rupture of the bladder, eleven; peritonitis from disease of the bladder, seventeen; pyemia, three; rupture of the peritoneum and vagina, two; improper efforts at reposition, five; gangrene of the intestine and peritonitis, one; occlusion of the intestine, one; and four cases in which the immediate cause of death is not described. Gottschalk in his paper reports an interesting case under his own observation in which the retroverted pregnant uterus produced intestinal occlusion without ileus. He performed abdominal section, but was unable to save the patient.

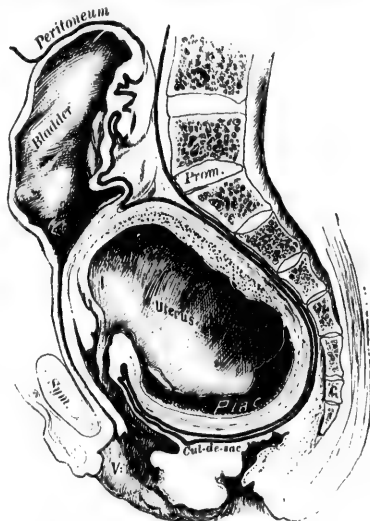


FIG. 143.—Frozen section of retroverted uterus of three and a half to four months. Death from rupture of bladder (*Arch. f. Gyn.*, Band 41, Taf. 8, f. 1).

Ectopic gestation may be simulated by a retroverted pregnant uterus, as in a case reported by Barbour,⁵⁵ in which the physical signs of retroversion in the pregnant uterus were perfectly present. In the treatment of this condition Cohnstein,⁵⁶ in treating five severe cases of incarceration of the pregnant uterus, first emptied the bladder by a stiff catheter, and then drew down the cervix and vaginal wall with a tenaculum, while the cervix was pressed backward by downward pressure behind the symphysis. While the cervix was drawn downward and backward by a tenaculum the fundus was raised with the free hand of the operator.

Retroversion of the pregnant uterus is occasionally found complicated by the existence of disease of the pelvic bones; in these cases the pelvic deformity is often such that spontaneous restitution of the uterus is impossible. It is then necessary to relieve the patient by operative means, and, as a last

resort, to extirpate the uterus *per vaginam* if possible. An interesting case of osteomalacia complicating retroflexion of the gravid uterus is reported by Benckiser;⁹⁷ efforts had previously been made to produce abortion and to puncture the fetal sac through the posterior vaginal wall.

The treatment of retroversion of the pregnant uterus when adhesions are present must be conducted with great caution. A gentle effort should be made to stretch the adhesions, gradually allowing the womb to regain its lost position: this is best accomplished by the use of the antiseptic wool tampon, combining with it an alterative application which shall aid in the absorption of exudates in the pelvis and shall loosen adhesions. At present a favorite remedy for this purpose is ichthyol, as follows:

Ichthyol,		℥j ;
Lanolin,		
Vaselin,	āā	℥jss.

An ointment stronger in ichthyol is occasionally employed with good results. Once or twice weekly the patient may take, with advantage, a hot vaginal injection if this be practised very gently. In cases of sudden and severe abdominal pain with great shock occurring in patients in the early months of pregnancy and with retroverted uteri prompt incision of the abdomen, with assiduous examination of the pelvic organs, may result in finding a small focus of infection or a ruptured adhesion, which can be dealt with successfully by surgical means. If such adhesions do not yield, abortion is inevitable, and especial precautions must be taken that septic infection is prevented in uteri so bound down.

The fact that hematosalpinx or pyosalpinx very frequently accompanies such peritoneal adhesions indicates the danger of rupture of such accumulations and of acute septic infection which may follow. Should such rupture occur, evidenced by pain in the abdomen and symptoms of shock, the abdomen should be opened at once, the parts be carefully inspected while the patient is in the Trendelenburg posture, and all foci of infection should thoroughly and completely be removed. With free irrigation with saline fluid and drainage it is possible that such a patient may escape general infection of the abdominal cavity.

2. GENERAL DISORDERS OF PREGNANCY.

THE URETHRA, BLADDER, and URETERS share during pregnancy the condition of increased vascularity and irritability that characterizes the pelvic organs. The bladder in early pregnancy is less capable of distention antero-posteriorly, and hence enlarges laterally as gestation goes on. In the latter months of pregnancy the uterus rises in the abdomen, drawing the bladder with it above the pelvic brim; this seems a conservative provision to protect the bladder from injury by pressure. The bladder accompanies the uterus in the displacements frequently seen during pregnancy. The urethra becomes elongated as the uterus rises in

the pelvis. The urethra may become completely or partly occluded in some of the uterine displacements observed during early pregnancy. If the displacement of the uterus be not corrected, there follow over-distention of the bladder, paralysis of its muscular layer, and decomposition of the retained urine, with erosion, ulceration, and final perforation.

Cystitis and hematuria complicating pregnancy demand rest in the recumbent posture, and if the inflammation of the bladder be gonorrheal in character, its careful treatment is strongly indicated. Labor in such cases, by making traction upon pelvic adhesions, may compress the ureters, favoring the development of uremic poisoning and eclampsia. Subinvolution of the uterus is very apt to occur in such cases, while the inflammation of the urinary tract may become chronic. Diphtheritic inflammation of the bladder is seen in cases where an incarcerated uterus prevents the passage of urine and where a catarrhal condition of the mucous membrane has previously been present. In cases where during pregnancy the germs of gonorrhea have been retained in and about the urethra, labor, by reason of the pressure and disturbance of the parts which then occur, may cause migration of these germs. Cystitis is the first result of such added infection, and later this infection travels up the ureters to the kidney, and acute parenchymatous nephritis may be the result: this whole process occupies several weeks for its full development and consummation, and its issue is usually fatal, the patient perishing from septicemia.⁵⁸

The Kidneys during Pregnancy.—There is abundant evidence to show that the kidneys share with the other viscera the congested and hypertrophied condition common during pregnancy. This peculiar engorgement of the kidney has given rise to the term "kidney of pregnancy." Much discussion has been elicited in the effort to differentiate the "kidney of pregnancy" from beginning nephritis. It is evident that only the systematic and microscopic examination of the urine can accurately determine whether simple congestion is present, or whether the kidney is being damaged in its essential elements, the secreting cells of the tubules. When such study of the urine finds only hyaline casts, crystals of various sorts, and the slight epithelial *débris* which may be found in healthy individuals, there is no reason to believe that nephritis exists; but when, on the other hand, epithelial, granular, or fatty casts are persistently present, the diagnosis of nephritis can scarcely be denied. It is upon such comparative examinations that a diagnosis must be based, and not upon the mere presence or absence of serum-albumin. Attention has recently been called by Trantenroth⁵⁹ to a condition of beginning fatty degeneration in the kidney which causes no symptom in the urine, and which may suddenly become so acute as to destroy the patient by sudden kidney failure. Infective process as present in these cases is so far wanting, and patients thus affected, if they survive pregnancy, do not become nephritic afterward. An acute inflammation of the kidney cannot be caused by pregnancy, and is only observed in the rare cases where infective bacteria find entrance to the genito-urinary tract

of the pregnant. This condition of congestion during pregnancy is increased during labor, and renal albumin is present during the progress of labor in considerable amount. Patients suffering from diseased kidneys and becoming pregnant have the kidney disorder greatly aggravated, often to a fatal issue. The causes of this condition, known as the "kidney of pregnancy," are the increased intra-abdominal tension to which all the viscera are subjected; disturbances in the nutrition of the kidney through an altered condition of the blood of the pregnant patient; and an engorgement of the spermatie veins and ureters by mechanical pressure. It is possible for eclampsia to develop without lesion of the kidneys, although in most cases of eclampsia a diseased condition of the kidneys can plainly be discerned. Fischer, in studying the same subject,⁶⁰ found in 70 cases evidence that the "kidney of pregnancy" was present in fifty-eight; eight cases of nephritis occurred among the 70 patients. Fischer found red blood-corpuscles in considerable amount in cases where acute nephritis occurred. Granular and epithelial casts indicated chronic nephritis. The occurrence of chronic endarteritis accompanying chronic nephritis explains the rupture of blood-vessels within the uterus and the intra-uterine hemorrhage which sometimes destroys these patients. Schauta⁶¹ describes a typical case of fatal hemorrhage in which chronic interstitial nephritis and degeneration of the muscle of the heart and uterus were found. The life of the child was also sacrificed.

Albuminuria is of such frequent occurrence during pregnancy as scarcely to require serious consideration, except as a symptom in connection with others of nephritis. Among others, Meyer⁶² from an elaborate study of this subject at Copenhagen found albuminuria in 5.4 per cent. of pregnant women. Casts accompanied the albumin in 2 per cent. This may be taken as an indication of the relative frequency of kidney involvement in cases manifesting albuminuria. As pregnancy advanced, albumin became more abundant until during the last thirty days but 28.9 per cent. of urine examined was free from albumin. Premature births occurred in 8 per cent. of patients with albumin, and in 21.5 per cent. of patients who had casts in the urine. He adds other clinical details which emphasize the significance of the presence of casts as indicating nephritis. Lantos⁶³ in the clinic at Budapest found albumin so frequently in pregnant patients that he considers it physiological during pregnancy and a diagnostic symptom of the condition. Herman calls attention in this⁶⁴ and in other papers presented at the Obstetrical Society of London to two conditions of renal disease in the pregnant woman: one is acute kidney failure with extreme diminution in the quantity of urine and deficiency in the excretion of urea, which quickly ends fatally if the excretion of urea is not re-established. The other process resembles interstitial nephritis in its slow course and ultimately fatal termination. The interesting fact that a patient may have uremic convulsions during pregnancy without eclampsia is illustrated by Boudin,⁶⁵ who describes a patient seven months pregnant admitted to the hospital unconscious with uremic convulsions. On establishing the secretion of urine and purging the patient, consciousness returned, and the follow-

ing day a seven months' fetus was stillborn. Symptoms of uremia supervened, but recovery finally ensued. The patient manifested no symptom of eclampsia and had no edema. The very interesting question of the prognosis in nephritis during pregnancy has recently received consideration at the hands of Koblanek.⁶⁶ In a series of 77 patients, 59.7 per cent. showed nothing pathological in the urine after their recovery from labor; 16.6 per cent. manifested slight involvement of the kidneys as shown by hyaline casts and leucocytes, with a trace of albumin; in 15.4 per cent. a catarrhal condition of the urinary tract was evidently present; in 6.5 per cent. the patients were the victims of nephritis.

The presence of sugar in the urine during pregnancy has been the subject of investigation by Berberoff:⁶⁷ his tests were thorough and minute, and his results were largely negative, a trace of sugar being present in some patients in early pregnancy, and disappearing as labor approached. Polyuria may be observed in the pregnant patient without a pathological condition of the urine, as in a case reported by Voituriat.⁶⁸ Among the most significant of the symptoms presented by pregnant patients suffering from nephritis may be reckoned albuminuric retinitis. Abundant evidence of the significance of this complication is afforded by the literature of ophthalmology upon the subject. In a recent paper Randolph⁶⁹ reports 5 cases, with a pathological study and drawings of the tissues involved: he regards visual disturbances occurring in the first six months of pregnancy, associated with violent headache, as very significant of albuminuric retinitis. If this condition be found, to save sight pregnancy should at once be terminated. Visual disturbances during the last seven weeks of pregnancy are of less grave import. The occurrence of renal retinitis in one pregnancy does not necessarily mean its recurrence in a succeeding pregnancy.

The treatment of disorders of the urinary tract occurring during pregnancy necessitates, first, a careful examination of the position of the uterus, inasmuch as pressure upon the bladder, ureters, and kidneys by a displaced pregnant uterus is so frequently a cause of disease. A retroverted uterus should be raised and be supported in proper position by tampons of antiseptic carded wool. Cystitis may be treated by douching the bladder with creolin or lysol, 30 drops to the pint or quart of warm water, as the patient's tolerance will permit. The administration of salol, of boracic acid, or of sodium salicylate internally is also of advantage. If the ureters become involved, catheterization of these ducts, the bladder having first been rendered aseptic, is indicated to determine which kidney is affected if pyelitis is present. Should this procedure show the presence of pus and bacteria in one kidney, the extirpation or the drainage of this organ is indicated. Such disorders, however, complicating pregnancy, are unfavorable and dangerous to the life of the patient. Should recovery occur, the patient is liable, after the birth of the child, to become the victim of some form of chronic nephritis.

Suppurating hydatid of the abdomen is an infrequent but dangerous complication of pregnancy. The diagnosis is made by the presence of an

abdominal tumor not attached to the uterus, and by the contents of this tumor obtained through tapping. An incision should be made through the abdominal wall, and the edges of the sac of the tumor be sewn to the edges of the abdominal incision. So soon as adhesion has taken place the cyst should be opened and its contents thoroughly removed. Pregnancy is not necessarily interrupted by this complication.

Peritonitis during pregnancy,⁷⁰ as has been stated, results in most cases from previous inflammation of the endometrium, the Fallopian tubes, or the connective tissue of the pelvis, caused by septic germs or their spores. There remain, however, cases in which no infection can be traced, but in which sudden exposure to cold or to dampness may produce rapidly-extending and fatal peritonitis; thus, instances are recorded where a cold bath taken while the patient was overheated, and accompanied by the drinking of cold fluid, was followed by rapidly-developing and fatal general peritonitis.

Mechanical injury or a severe strain may be followed by peritonitis in a pregnant patient. Gow⁷¹ reports the case of a patient advanced in pregnancy who slipped through a hole in the floor of a building; peritonitis supervened; the patient was delivered by version, but ceased breathing during delivery. Abdominal incision disclosed no blood in the peritoneal cavity, but lymph was found upon the peritoneum and uterus. No evidence of rupture of the uterus or other organ was discovered. No focus from which the inflammation could have begun was found upon examination.

Concealed accidental hemorrhage is among the most dangerous complications of pregnancy. One of the most extensive recent collections of such cases is that by Storer,⁷² who contributes an account of 46 in his own observation, and adds the collection of 84 cases by Goodell and 23 by Braxton Hicks, making a total of 153: 46.7 per cent. of the mothers perished, and of the children 94 per cent. Of 63 cases which received no treatment, 64 per cent. died, while in 79 cases in which the condition was detected and treated, 29 per cent. died. It is thus apparent how insidious is the danger and how difficult is its recognition in these patients. There is contributed by Jardrin⁷³ a further series of these cases, the results of which differ in no particular from those observed in the more extensive series of Storer. As so much importance naturally attaches to a diagnosis of this complication, it must be remembered that the hemorrhage is concealed, and that the patient may be thrown into a condition of danger without apparent flow of blood: her symptoms then will divide themselves into two classes—namely, those pertaining to her general condition, and those which have to do with the uterus itself; of these, the first furnishes the best indications of danger and the most rational suggestions for treatment. A rapid, weak pulse, lacking in tension; an indifferent, languid attitude of mind; respiration becoming more and more shallow; a pale or pallid face; a clammy skin; thirst; dimness of vision and “air-hunger;” a restless irritability which is a very significant symptom of a certain kind of shock,—these furnish an array of symptoms which should attract the attention of the physician.

If concealed accidental hemorrhage occurs during labor, labor-pains may cease or may grow weak, and the usual sensation of pain in the uterus may be replaced by a dull constant ache above the pubes. It is occasionally noticed that the *os uteri* is dilating without apparent labor-pains. The uterus may become enlarged, forming an asymmetrical tumor of the abdomen which can be appreciated by palpation. As regards those symptoms which can be observed on making an examination of the genital tract, the *os uteri* is usually slightly dilated, and the cervix is softened, although it may not be effaced. Slight uterine hemorrhage is generally observed. The lower uterine segment becomes distended with clot; as the hemorrhage persists the sensation conveyed to the finger resembles that in placenta prævia. Ineffectual and spasmodic uterine contractions and the accumulation of blood between the fetus and the wall of the uterus will cause irregular enlargement of the womb.

Concealed accidental hemorrhage from some other source than the uterus or the placenta may occur during pregnancy, the blood escaping into the abdominal cavity. An illustrative case is reported by Sutugin⁷⁴ of a multi-gravida who, three days before admission to the hospital, had fallen while carrying a heavy load. Two days after her fall she was seized with weakness, and felt no fetal movements after this time. When examined, no dilatation of the *os* and cervix was present. The fetal heart-sounds were absent. The patient complained greatly of pain in the uterus, probably caused by uterine contractions. Shortly after delivery the patient had clonic spasm of the extremities, and died in collapse. On post-mortem examination a large amount of clotted blood was found in the abdomen. The source of the hemorrhage was a torn vessel of the mesocolon. The uterus contained a fetus nearly at term and dead.

As regards the *diagnosis* of this condition, it must be based upon symptoms of prostration and shock greatly out of proportion to the amount of hemorrhage that may be present. The dangerous character of this complication of pregnancy and labor should lead the physician to take alarm promptly and to interfere as quickly as possible. The method of interference will depend somewhat upon whether the hemorrhage occurs during labor or before the beginning of actual labor. One of the most plainly indicated expedients in these cases is rupture of the membranes, which will lead to a closer coaptation of the uterus upon the fetal body, thus making pressure upon its blood-vessels. Accompanying this rupture, the administration of ergot or ergotin is indicated for similar reasons. Treatment by these expedients may be considered the expectant method, which, in 63 cases reported by Storer, gave a mortality of forty. Rapid dilatation of the *os* and cervix and delivery by version or by the forceps give a better prognosis, as in 18 forceps deliveries four deaths are reported. Where, however, the hemorrhage is sudden and severe, and the birth-canal is not sufficiently dilated to permit delivery, the uterus should be emptied, and the bleeding be controlled by abdominal incision and hysterectomy or by total extirpation of the uterus. The use of the tampon of antiseptic gauze is indicated in cases where hemorrhage externally is considerable and

the os and cervix are too tightly closed to permit of rapid delivery. In introducing the tampon it is well to pack the end of the strip of gauze into the os and cervix, thus furthering dilatation and checking external hemorrhage. The *prognosis* for the fetus in these cases is exceedingly grave and is almost necessarily hopeless. Loss of blood induces rapid asphyxia, and the rapid fetal movements accompanying the partly asphyxiated state may explain some of the obstinate uterine pains from which these patients suffer.

The causal relation existing between involvement of the kidneys and intra-uterine hemorrhage has been described in treating of *Nephritis* and its consequences. In a series of clinical lectures upon the subject of hemorrhage during pregnancy Budin⁷⁵ describes the case of a patient suffering from hematuria with albuminous urine. Profuse intra-uterine hemorrhage complicated labor; the child perished.

The Posture and Bearing of the Pregnant Woman.—Accompanying the changes in the pelvis peculiar to pregnancy we find certain variations in the posture and bearing of the patient as pregnancy advances. This has been the subject of study by Kuhn⁷⁶ who found two types among patients in the latter months of pregnancy. The most frequent is a backward curve of the entire body, while in 20 per cent. of cases a backward bend of the trunk only was present. The cervical vertebrae are straighter, the thoracic curve is greater and more projecting, the lumbo-dorsal region is straighter, its curve being lower and flatter, while the pelvic curve is often lessened in the later months of pregnancy, and is sometimes unchanged. The hip-joints are usually carried posteriorly, while the sternum projects at its lower extremity, increasing the diameter of the thorax.

Relaxation of the Pelvic Ligaments.—Among the general changes caused by pregnancy are those affecting the joints of the pelvis. The fact that an increased secretion of synovial fluid is present in the pelvic articulation during pregnancy has long been recognized, and has been accurately studied by Driver:⁷⁷ in his examination of 300 cases he found the amount of relaxation is proportionate to the general strength and firmness of the patient's tissues. Age has nothing to do with it, nor does the amount of relaxation influence the patient's walking. Some of those whose joints were most relaxed could walk without difficulty; conversely, considerable motion produced in some patients marked lameness. Pain at a sacro-iliac joint showed that the ilium moved upon the sacrum upon that side. This phenomenon is sometimes observed in patients who are not pregnant. Some patients recovered spontaneously from a serious condition of lameness, while others were not benefited by prolonged and thorough treatment. A slight degree of relaxation may facilitate delivery and obviate the use of forceps. The most successful treatment described was an abdominal bandage of twilled cotton 5 inches wide, with padded perineal bands 1 inch wide. Where the patient was deficient in general strength cold baths and massage were sometimes useful.

The Toxemia of Pregnancy.—The interesting metabolism characteristic

of pregnancy has not yet been sufficiently elucidated to explain clearly the origin of toxic material which not infrequently jeopardizes the lives of mother and child. The fact that nutrition and its converse are going on in two organisms, each dependent upon the other for proper assimilation and excretion, explains the ease with which these processes may pass the bounds of physiological activity and become disease. The character of the poisons produced in the body of the mother and the fetus places them, so far as we know, in the class of animal poisons, alkaloidal in nature, denominated toxins. The symptoms they produce upon the pregnant patient are especially addressed to the nervous system, hence the study of toxemia in pregnancy appropriately leads to a consideration of nervous disorders during this condition.

Various observers by differing methods of investigation have isolated several poisonous principles from the urine of pregnant women in whom elimination was deficient: Dührssen⁷⁸ lays great stress on the retention of creatin and creatinin in the kidneys of the pregnant patient. Actual nephritis he rarely observed, but congestion and accumulation of urine through pressure upon the ureters and by hydronephrosis are common. Creatin and creatinin accumulating in the vessels of the cerebral cortex produce cerebral irritation. It is natural that such a condition should be commonest in patients in whom excretion is habitually deficient. Poisons absorbed from the intestinal tract stand in close relation to the toxemia of pregnancy, as shown by Budin.⁷⁹ This is especially true where retroversion of the pregnant uterus produces intestinal stasis. In many of these cases the bacterium coli communis penetrates the wall of the bowel, causing peritonitis in adjacent tissues.

Culture experiments by inoculation demonstrating the toxicity of urine in pregnancy have been performed by Charpentier,⁸⁰ who, following Bouchard's researches, injected such urine into rabbits, producing tetanic convulsions and speedy death. Acute congestion in the kidneys of these animals was the only lesion found to account for the fatal issue. Similar injections beneath the skin of other animals less susceptible than rabbits produced death after longer intervals. The condition of congestion of the kidneys in patients suffering from toxemia in pregnancy is also described by Prutz.⁸¹ He notes a very interesting point, that but slight structural alterations were present in many exceedingly severe cases of toxemic poisoning. In the kidneys of infants born from mothers suffering from toxemia there were observed congestion and transudation of serum, with the formation of casts in the tubes and great distention of the veins. A similar congestion in the livers of toxemic patients is described by Pilliet and Delansorme.⁸² This condition of congestion in the kidney of the pregnant woman was found in two-thirds of the cases examined by Fischer during the second half of pregnancy.⁸³

The state of the blood in these patients has been studied by Blanc,⁸⁴ who made cultures and inoculated animals with their products, producing albuminuria and suppression of urine. Convulsions were also caused, and intense congestion of the kidneys was observed. Additional testimony as to the extensive disorganization of the blood and the pathological condition of the liver in the

toxemia of pregnancy is afforded by Papillon and Audain.⁸⁵ The accumulation of ptomaines in sufficient quantities to produce poisoning has been observed by Koffer and Kundrat.⁸⁶ Paultauf and Kundrat have also reported similar cases in the *Records of the Pathological Institute of the Vienna University*.

Among many interesting contributions to the bacteriology of this question is that made by Gerdes.⁸⁷ In common with other observers, he is inclined to ascribe to bacteria a causal relation in these cases. As bearing upon this point we note the observations of Tarnier and Chambrelent,⁸⁸ who found in toxemic pregnant women that the degree of intoxication present could well be estimated by observing the toxicity of the blood-serum of these patients. It is interesting in this connection to note that any disorder caused by bacterial invasion predisposes to toxemia in pregnancy; thus, Lang⁸⁹ finds that twice as many pregnant women who are syphilitic show symptoms of threatened toxemia in pregnancy as are observed in non-syphilitic pregnant patients.

The precise toxic agent responsible for the gradual development of toxemia with threatened eclampsia has not yet been isolated, although a number of substances have been charged with this result. The significance of a diminished quantity of urea in these cases has been brought to the attention of the profession by Hermann⁹⁰ and Davis;⁹¹ the latter in 84 cases, with a total of 564 examinations to determine the amount of urea present in the urine of pregnant and parturient women, found that the average percentage of urea in the urine of a healthy patient before labor was 1.4. After delivery this percentage increased to 1.9. Considerable diminution in this quantity was first accompanied by symptoms of irritation of the nervous system and threatened intoxication, and, where the patient's excretion was not stimulated and the amount of urea brought up to nearly normal, eclampsia developed. Davis does not ascribe to retained urea the causal rôle in toxemia, but he regards it as a valuable index in estimating the excretory activity of the patient.

A well-marked example of ptomain-intoxication during pregnancy is the case described by Gustav Braun.⁹² The patient, seven months pregnant, died from pulmonary edema after premature labor. The urine contained casts and albumin. The post-mortem examination was made by Paultauf, who found fatty liver, fluid blood, nephritis, and cerebral edema. Multiple rupture of capillaries was found in the viscera. The fact that the blood of patients suffering from toxemia may contain pathogenic germs has been illustrated by Blanc,⁹³ who made cultures from the blood of such a patient, obtaining in forty-eight hours germs which caused albuminuria and toxemia in rabbits. It was found on experimenting that chloral in the proportion of 4 parts to 1000 of the culture-liquids effectually destroy these germs. Blanc⁹⁴ continued his experiments by injecting the urine of pregnant patients into the bodies of rabbits and observing the result. It was found that while the urine of some non-pregnant patients was poisonous when injected, the urine of pregnant patients was far more toxic, causing distinct phenomena of decided poison. Van Santvoord⁹⁵ from clinical observation ascribes toxemia during pregnancy very largely to deficient action of the

liver, by which an insufficient formation of urea causes the patient to retain in her blood toxic material. The immunity which the kidneys display in some of these cases is illustrated by Prutz's description of the condition of the kidneys in 22 cases of fatal toxemia. In many of these, beyond a general congestion, no pathological condition was found. Micro-organisms were absent from the kidneys, and there was no relation between the severity of the intoxication and the condition of the kidneys. The belief that peptones are among the substances causing toxemia has led observers to study the urine of pregnant patients with regard to the presence or absence of these substances. Thomson⁹⁶ examined the urine of 23 pregnant and puerperal women for peptone; the results of his examination were negative. Koettwitz⁹⁷ made 140 analyses of the urine of 31 pregnant patients, but could not discover that peptone is a significant ingredient in these cases. It is often present in the urine of patients who suffer during pregnancy from any severe complication.

While the entire subject of the toxicity of urine offers a vast field of investigation and has produced a large literature, so far as the obstetrician is concerned there is abundant proof that no one substance is especially dangerous to his pregnant patient, but that the gradual accumulation of nitrogenous waste, of potassium combinations, and of animal alkaloids produces a condition of toxemia, the symptoms of which are first observed in a disordered state of the nervous system demanding the attention of the physician. Following the line of Bouchard, additional observation is required for a more precise determination of the relative toxicity of the various substances retained in the blood in these cases.

The prophylaxis of the toxemia of pregnancy resolves itself into maintenance of excretion. Remembering the interference with the circulation to which the patient is subjected by pressure, a first and very important precaution is to secure suitable clothing. There can be no question of the advisability of laying aside completely the corset or any other form of support for skirts that compresses the abdomen and forces the viscera down upon the brim of the pelvis. The art of dress has advanced sufficiently to enable the patient to obtain comfortable and shapely clothing supported entirely from the shoulders. Poor patients can make for themselves from cheap materials waists which fulfill the same indication. While the intelligent physician will advise and strongly urge that the corset be laid aside, he will remember that this is one of the pieces of medical advice which is expected and is rarely followed. The responsibility, however, is not his after he has stated the case fairly and clearly to his patient. Constriction of the blood-vessels should also be avoided by wearing loose shoes, by dispensing with garters that encircle the legs, and by the avoidance of constipation so far as possible. In this latter difficult problem it will be found that a proper mode of dress is of the utmost importance by avoiding pressure upon the large intestine. In avoiding constipation it is well for the patient in addition to select a diet not rich in nitrogenous elements. The heavier and less digestible meats should be omitted. Birds, lamb, mutton, fish, and oysters are best adapted for such

patients. An abundance of raw fruit, or cooked fruit if the digestion requires it, is of great importance. Whole wheat, Graham, and rye bread is of value. The avoidance of large amounts of sweets and stimulants of every form is also indicated. While vegetables are useful, they are inferior to fruits for the needs of such patients. An abundance of water is a prime necessity. If the patient cannot obtain bottled waters, ordinary drinking-water which has been boiled and filtered may be taken in abundance. If her means allow her to choose, she will find the lightest Vichy or any of the slightly alkaline and effervescing waters agreeable and advantageous. Milk is to be taken freely by those with whom it agrees; many, however, cannot use it without producing obstinate constipation. The medicinal treatment of intestinal torpor threatening toxemia consists in the use of such laxatives as can be employed for a considerable time without violent purgation and without losing their effect. Compound licorice powder in small quantities, rhubarb or colocynth in combination with extract of belladonna, small quantities of the heavier mineral waters (such as Hunyadi János) and cascara sagrada in combination with the substances mentioned, have been found efficient. Where the liver is evidently at fault, the occasional use of calomel and soda, followed by a saline, is distinctly indicated. Where hemorrhoids complicate the patient's constipation, rectal suppositories of glycerin 1 drachm, extract of belladonna $\frac{1}{2}$ grain, and iodoform 5 grains will be found advantageous.

In addition to avoiding constipation, the prophylaxis of toxemia embraces such care of the skin as shall promote constant and free elimination. Frequent bathing in tepid water, flannel (varying in weight in accordance with the climate) worn next the skin, massage of the limbs and the upper portion of the trunk, and gentle exercise are not to be neglected. Remembering the important part which the lungs play in excretion, and the necessity for a free supply of oxygen, the patient must have an abundance of fresh air. A mild and equable climate is naturally the best for such cases, but, as this is seldom available, the patient, properly clad, should be out of doors in all weathers. It is of importance that the amount of urine secreted be observed, hence the patient should be instructed to take such precautions that this information is available for the physician. He may inform her that an amount varying within certain limits is what is expected and desired, and that any marked decrease from this should at once be reported to him. Examination of the urine of pregnant patients should be an invariable custom not to be omitted in any case. It should be done at least once a month through the entire pregnancy, or, better, once in two or three weeks. While this imposes additional labor upon the physician and inconvenience upon the patient, yet in all cases of primigravidæ, especially in women whose nutrition and excretion are not of the best, "Eternal vigilance is the price of safety." If this be reasonably explained to a patient, she will rarely object. The examination of the urine in pregnancy requires chemical and microscopic investigation. By the first we search for albumin, sugar, and urea in all cases. Important as this examination is, it is second in value to the microscopic

study of the specimen. By this study we derive positive and valuable information as to the condition of the parenchyma of the kidney, and this information can be obtained in no other way. Hence in pregnancy an examination of the urine that does not include its microscopic study is certainly superficial and deficient. In cases where a suspicion exists that toxemia is developing, in addition to the substances already mentioned we must examine chemically for indican, acetone, peptone, pus, and blood. In complicated cases microscopic examination must be patient and thorough.

Diagnosis.—In diagnosing the toxemia of pregnancy two clinical signs are of especial value: first in importance are the amount and character of the excretions; second is the condition of the nervous system. The first sign is to be ascertained by careful questioning and accurate observation. The second sign must be determined by closely interrogating the various functions of the patient's nervous system. The presence or the absence of pain, headache, thirst, lassitude, disturbances of vision, of hearing, or of taste, sleeplessness or lethargy, irritability or apathy, melancholia, and nausea and vomiting, are all symptoms to be recognized or be eliminated. The condition of the skin, as affording evidence of the functional integrity of its excretory apparatus, is of great value. Of secondary importance are the occurrence of swelling of the feet and legs and the presence of serum-albumin only in the urine.

The treatment of the toxemia of pregnancy consists in the prompt stimulation of all the eliminative organs of the body. In view of the hepatic condition present there can be no question regarding the efficiency of mercurials in a few repeated doses. The remarkable diuretic effect of calomel is also of value in these cases. In selecting saline cathartics it is best to avoid those containing potassium salts, as potassium has been shown to be an irritative element in the urine. Those purgatives producing a free flow of watery fluid from the bowel, such as colocynth, elaterium, and jalap, are especially indicated. Rectal injections of glycerin, combined with sodium salts and spirits of turpentine, are excellent in producing copious watery evacuations. The beneficial effect of such eliminative treatment on the nervous system is remarkable in many cases, the patient passing from a condition of melancholia and great restlessness to a feeling of comfort and good health. Warm and hot baths in these cases, taken before retiring, are an excellent means of treatment. If the patient's symptoms are threatening and a condition of hysteria is present, the hot pack will prove a most valuable resource. The diet in cases of toxemia should be restricted to milk, fruit, bread, and, if the patient requires more than this, fish, oysters, and gruel. Meats, eggs, vegetables, pastry, and all forms of stimulants, including tea and coffee, should absolutely be forbidden while symptoms of toxemia are present. In examining the urine two points are especially valuable: one is the amount passed daily; the second, the amount of urea excreted by the patient. If the condition of the kidney passes beyond congestion to actual nephritis, the practitioner will be aware of this through the microscopic study

of the urine, when casts, bloody, epithelial, or fatty, will be present. The presence of serum-albumin and hyaline casts is of very little moment so long as a free amount of urea is excreted, and microscopic study of the urine finds no evidence that the parenchyma of the kidney is diseased.

It is evident from what has been stated regarding the toxemia of pregnancy that simple albuminuria is of little moment in the pregnant condition. The complications of pregnancy ascribed to albuminuria do not result from the presence of serum-albumin in the urine, but from the circulation through the body of the mother and her placenta of blood rendered irritating by toxic material. The occurrence of thickening and induration in the walls of the placental blood-vessels, the partial separation of a placenta in fatty degeneration following this process, with the consequent hemorrhage and asphyxia of the fetus, are familiar complications of the toxemia of pregnancy and they follow the diffusion of toxic material in the placental blood. Simple albuminuria is often seen in multigravidae in whom, by reason of the large size of the fetus or by the relaxed condition of the uterus and the abdominal walls, the ureters are pressed upon and the kidneys are in a constant state of congestion and accumulation of urine. Many of the women thus affected have edema of the extremities, they remain entirely free from those disturbances of the nervous system seen in toxemia. The condition of such patients does not demand the production of abortion, but it requires that the heart-muscle be stimulated, the circulation be maintained in every way, and, if possible, that the pressure of the pregnant womb upon the ureters be relieved by a supporting bandage when it can be used.

In sharp distinction to these cases are those of the toxemia of pregnancy, where, notwithstanding prompt treatment addressed to the organs of elimination, the patient's nervous symptoms continue, while her excretory processes are plainly deficient. In such cases, in the present state of our knowledge, the prompt termination of pregnancy is the only rational and conservative treatment. If the toxemia of pregnancy be recognized and the patient will submit to her physician's advice, eclampsia should become more rare than puerperal septic infection.

The tendency which patients who suffer from toxemia of pregnancy exhibit to pass into nephritis after pregnancy or during a subsequent gestation must be borne in mind. In a woman who has once shown marked evidence of the toxemia of pregnancy each succeeding gestation brings added risk of fatal poisoning. If her condition be undetected and her general health after parturition be neglected, she will not infrequently become the victim of nephritis.

DISORDERS OF THE NERVOUS SYSTEM IN THE PREGNANT PATIENT.—*Neuralgia*.—The pregnant patient is peculiarly susceptible to various disorders of the nervous system. Common among these affections, and occasioning great distress, are the various forms of neuralgia often observed during gestation. As is generally the case, these neuralgias usually have as a starting-point some portion

of the nervous system in which a pathological condition is present. The decay of the teeth so often seen during pregnancy accounts for many of the cases of obstinate toothache which annoy and distress these patients. In women who suffer from habitual constipation during pregnancy, and in whom the size of the fetus is so great as to cause pressure upon the nerve-trunks at the brim of the pelvis, obstinate cramp and sciatic pain may occasion great distress and may seriously depress the patient's general health. Some of the worst of these cases result from the pressure of hardened fecal matter upon nerve-trunks above the brim of the pelvis, and upon branches of nerves so situated that they may be pressed upon in the pelvic cavity. In some of these cases the uterus will be found retroverted, thus preventing proper evacuation of the bowels and adding to the pressure which retained fecal matter causes. In other patients there is great complaint of cramp and of sudden spasmodic contraction of the muscles of the thigh, often worse at night. Where the disorder is severe an obstinate pain, radiating down the thigh as far as the knee or even below the knee, is often observed.

In dealing with these cases the first duty of the obstetrician is to ascertain accurately the position of the uterus: if it be found retroverted and not bound down by adhesions, it is a comparatively simple matter to raise it to or above the brim of the pelvis, and to sustain it by tampons of carded wool. If the uterus be found bound down by adhesions, the problem is much more difficult. If the patient be put at rest in bed and the bowels be thoroughly moved by salines, a very efficient form of tampon in these cases may be found in a strip of surgeon's lint 3 or 4 inches wide thoroughly soaked with glycerin. A Sims speculum is introduced, and this strip is packed with the aid of dressing-forceps thoroughly behind the cervix, pushing the uterus up as far as possible without causing positive pain. This application is followed by a very copious discharge of watery mucus, greatly relieving congestion and softening adhesions which are not extraordinarily tenacious. The growth and development of the uterus will frequently separate such adhesions, and surprisingly good results are observed in cases where the uterus has been partially bound down in the pelvis. The fact that pregnancy exists contra-indicates, naturally, uterine massage and any instrumental interference.

If the uterus be in good position, the next step to be taken in relieving pelvic pain radiating down the thighs is to empty the bowel thoroughly: this should be done with the same care exercised in preparing a patient for an abdominal section. In addition to the purgatives usually employed, the colon should be flushed thoroughly by frequent and copious injections of warm water and sulphate of magnesia, or injections containing soapsuds and castor oil to which turpentine is added. If impaction of feces is present, an ounce of ox-gall dissolved in a quart of hot soapsuds should be injected through a rectal tube as high into the bowel as possible. This injection is to be retained so long as the patient can do so, and when an inclination to evacuate the bowels is felt a second injection of sulphate of magnesia, glycerin, and turpentine will usually result successfully. Some cases of obstinate pelvic

neuralgia occurring during pregnancy are cured by emptying the bowel of hard and irritating feces.

Where the uterus is in proper position and the intestine is free from fecal matter, if pelvic neuralgia still persists, it will be found to depend upon anemia, depressing causes which affect the nervous system, or, possibly, upon malarial infection. Treatment appropriate for this condition will result in the gradual relief of the neuralgia.

Facial neuralgia with hemicrania is often observed in pregnant patients in whom no exciting cause in bad teeth can be discovered. Many attacks follow exposure to cold or to damp; others are caused by loss of sleep. The pain is often paroxysmal, and frequently an irregular interval may be observed between the attacks; thus, some patients will sleep during the night, but are seized with violent pain in the early morning; others suffer more in the afternoon or at night. The face and scalp are often tender to pressure in these cases, and the conjunctivæ on the affected side are frequently reddened.

Where painful spots can be isolated local treatment may be instituted by painting the part with menthol or with iodine, or by spraying it with ether or with some other anesthetic. The constitutional treatment of this condition consists in thoroughly emptying the intestine to relieve the patient of fecal poison which may be depressing the nervous system. Absolute rest in a darkened warm room of equable temperature, systematic feeding of easily-digested food, and tonics—iron, arsenous acid, and quinin—and, if the pain be severe, alcohol, at regular intervals are to be recommended. When sleep is impossible by reason of pain, phenacetin with caffeine and sodium bicarbonate is often used to advantage. If pelvic neuralgia be present, phenacetin may be given by rectal suppositories of 10 grains each. Morphia and atropia may be given hypodermatically when other remedies fail. Chloral and the bromids are of comparatively little value and often disappoint in these cases. It should be explained to the patient that the less opium she takes the sooner she will recover; and where her suffering is not severe every effort should be made to improve her general condition by tonic treatment rather than by narcotizing her with opium.

Salivation.—Derangement of various secretory nerves is sometimes observed during gestation; the salivation of pregnancy is a familiar instance. Hypersecretion of tears is seen in patients suffering from salivation, as shown in a case reported by Neiden.⁹⁸ So abundant was the secretion as to keep the eyes continually suffused and to cause an eczematous eruption of the lids. The tear secretion was weakly alkaline, the eyes were normal, and no appreciable cause was found for the condition present. The patient was finally cured by a 5 per cent. cocain solution. Salivation of pregnancy is a most obstinate and annoying condition often repeated in subsequent pregnancies and resisting all forms of treatment. It is without apparent cause, as a rule usually affecting women of nervous temperament, especially if the general health be depressed. Treatment is usually palliative only, and it should consist in the free administration of tonics and in those milder sedatives which interrupt least of all the patient's

nutrition. The bromids have been given freely, both by the stomach and by spray applied to the interior of the mouth. Cocain may also be sprayed into the mouth, the effort being to cocainize the mucous membrane near the opening of Steno's duct. This condition rarely if ever becomes serious. Another form of abnormal secretion occurring in pregnancy is that of excessive perspiration, which is commonly met with in poorly-nourished and neurasthenic cases.

Herpes is found among the interesting disorders of the nervous system to which the pregnant patient is liable. Fournier⁹⁹ reports a case in which the lesions were distributed irregularly over the body, especially upon the forearms, the anterior part of the thorax and feet, and the abdomen. Accompanying these lesions were patches of redness, in some instances these areas being covered with bullæ as large as an olive or a small cherry. The usual period of pregnancy at which this disorder occurs is between the third and the fifth month, occasionally as late as the sixth or the eighth month. In other cases, more rare, the lesion does not show itself until the second or the third day of the puerperal period. There is a strong tendency in this disorder to recur during subsequent pregnancies, and instances are given where the patient has suffered from herpes during five successive gestations. Although intolerable itching and burning accompany herpes during pregnancy, yet the general health remains remarkably unaffected. The occurrence of gestation is not influenced by this complication, and patients usually recover promptly when gestation terminates. Herpes in the puerperal period is often characterized during its onset by fever, perspiration, and general pruritus. In from twenty to twenty-four hours after these symptoms occur the characteristic eruption appears. The remarkable tendency of herpes to recur is illustrated by the cases of Cottle, Wilson, Gale, and Hardy, the last of whom describes a patient who suffered in nine out of ten pregnancies with this disorder.

There is no evidence that the fetus and its appendages are affected in this disease. Occasionally mixed forms of the eruption are seen, some of them resembling pemphigus and others assuming a syphiloid type. It is noticed that young women are oftener attacked by herpes than those older.

The treatment of herpes consists, first, in properly regulating the functions of the body. Herpetic patients are generally depressed or in some manner are deficient in nervous energy, and they will be found to improve under the prolonged use of arsenic, hypophosphites, and iron. The great number of remedies which have been administered as specifics in this disorder, and their failure to influence the course of the disease, show that it is not amenable to specific treatment. When the eruption first begins borated vaselin, glycerol of starch, and lime-water and oil will be found soothing applications. When the eruption is fully developed bismuth and starch and starch-and-talcum powder are useful dressings. For the intolerable itching, applications of carbolic acid, hydrate of chloral, menthol, or corrosive sublimate in solution have been found useful. When a large portion of the body is involved, baths containing starch, gelatin, or bran may be employed.

While the prognosis of herpes complicating gestation is favorable so far as the continuance of pregnancy is concerned, still this complication exercises a most depressing influence, and may lead to complicated labor by reason of exhaustion. Care should be taken, then, to support the general strength of the patient in every possible way, to promote her nutrition by a carefully-ordered diet and the persistent use of tonics, and to see to it that during labor her strength is conserved in every possible manner.

Sudden death during pregnancy may result from the entrance of fluid or of air into the enlarged sinuses of the uterus. Hektoen¹⁰⁰ narrates the case of a patient who, while taking a vaginal injection, fell dead: it was found that she had been using a Davidson syringe. The autopsy showed the tissues of the uterus filled with air and blood and the placenta partially detached, while the right ventricle contained frothy blood, but no clot. Air was found in the subserous vessels and also in the vessels of the pericardial and pleural cavities.

The condition of pregnancy seems to predispose to sudden heart and respiratory failure. This is especially the case where nausea and vomiting have been well marked during the first months of pregnancy. McCabe¹⁰¹ reports the case of a patient who desired relief from obstinate nausea and vomiting, and to whom morphia had been given by hypodermatic injection. As it was impossible for the attending physician to see her at short intervals, a hypodermatic injection was prepared by him and left for administration during his absence. She seemed relieved, but a few days after, on attempting to move, a sudden weakness developed, terminating almost immediately in death.

The same observer describes the case of a young woman who during her second pregnancy was much annoyed by intense pain over the uterus and across the lower part of the back, simulating after-pains. A hypodermatic injection of $\frac{1}{4}$ grain of morphia was given, which made the patient easy. It was found that she had miscarried the night previous at about two and a half months of gestation. There was no sign of puerperal septic infection, but a rapid and weak heart caused the patient much distress. During the night following she suddenly sprang from her bed, and almost immediately expired.

As in both the above cases morphia had been given by hypodermatic injection, the relation borne by this drug to the phenomena observed is of interest. It would seem from these cases that morphia hypodermatically is a dangerous drug to be administered to pregnant patients.

Cerebral thrombosis and hemorrhage during pregnancy are illustrated in a case reported by Horrocks,¹⁰² in which a patient in her second pregnancy developed stupor and drowsiness with rectal and vesical incontinence during the last month of gestation. The pupils were equal and symptoms of palsy were wanting. The urine contained neither albumin nor sugar. The heart seemed normal, and labor subsequently came on spontaneously. Consciousness, however, was obscured, and derangement in the motor apparatus of the brain and nervous system was evidently present. After death many of the cerebral veins were found occluded by thrombi. There was also recent

extravasation of blood along the internal capsule. Cystitis and suppurative nephritis on one side existed.

Meningitis during pregnancy is almost invariably fatal to the mother, and frequently to her child. Chambrelent¹⁰³ describes 7 cases of acute meningitis during pregnancy, in six of which labor was terminated artificially with the birth of a living child. In one case birth was spontaneous before the mother's death. In view of the grave nature of this complication labor should be induced in cases of meningitis during pregnancy where the fetus is viable, in the hope of saving the life of the infant.

Spinal Irritation complicating Pregnancy and Labor.—The hyperemic and hyperesthetic condition characterizing pregnancy exaggerates all forms of functional nervous disturbances or pathological conditions in the nervous system. Spinal irritation is not infrequently observed, and it is well illustrated by cases reported by Napier.¹⁰⁴ The symptoms were great tenderness on pressure along the spines of the vertebræ, and in one patient fatal albuminuria gradually developed. These cases followed an epidemic of diphtheria which prevailed four or five years prior to these observations: the poison of diphtheria seemed to lose its activity by attenuation. Cases of cerebro-spinal meningitis developed as the epidemic died away, and last of all occurred the cases of pregnancy complicated by great tenderness along the spine, which tenderness seriously impaired the patients' strength and hindered convalescence. A toxic condition following widespread diffusion of diphtheritic poison should be considered as the cause of these cases, but the phenomena of spinal irritation were predominant.

Maternal impressions are familiar to all obstetricians of extensive reading and experience. It is not the writer's purpose to consider the matter in detail, but simply to draw attention to the fact that a pregnant patient may undoubtedly so profoundly be influenced by nervous shock as very markedly to alter the development, the shape, the size, and the appearance of her offspring. In recent literature on the subject Mackay¹⁰⁵ describes five cases in which fright produced distinct birth-marks upon the fetus. The writer may add a case under his personal observation in which a pregnant woman was informed that an intimate friend had been suddenly killed by being thrown from his horse: the immediate cause of death was fracture of the skull, produced by the corner of a dray against which the rider was thrown. The mother was profoundly impressed by the circumstance, which was minutely described to her by an eye-witness. Her child at birth presented a red and sensitive area upon the scalp exactly corresponding in location with the situation of the fatal injury in the rider. The child is now an adult woman, and this area upon the scalp remains red and sensitive to pressure, and is almost devoid of hair.

Space need not be taken to discuss the question of maternal impressions. There is certainly more than coincidence in the fact of fright and shock and the subsequent malformation or marking of the fetus. The well-known "elephant-man" of England, and the "turtle-man" exhibited in the United States, with other instances, are familiar evidences of this statement.

Chorea during Pregnancy.—There is no disorder of the nervous system so manifestly aggravated by pregnancy as chorea. The physiological plethora characteristic of normal pregnancy seems to exaggerate the functional activity of the nervous system, and it results in marked exacerbation of all pathological phenomena. The characteristic choreic movements occasionally extend even to the uterus, as in a case reported by Braxton Hicks.¹⁰⁶ The patient was a young woman who had suffered from chorea in childhood: the uterus, which could be outlined distinctly in the abdomen, presented marked alterations of form, accompanied by very evident choreic contractions. These uterine movements became less violent as the patient was treated by rest in bed and by the administration of arsenic: she was subsequently delivered in normal labor, making a good recovery.

In an elaborate essay upon the subject McCann¹⁰⁷ divides cases of chorea occurring in pregnant patients into cases of true chorea, of hysterical chorea, and a mixed form. It is rare to find chorea occurring in patients after the eighteenth year, except during pregnancy. Primigravidae are more susceptible to chorea than are multigravidae, especially to true chorea. In patients free from rheumatism it is rare for true chorea to occur in any but the first pregnancy. When the exaggerated reflex condition which occurs in chorea is called to mind, it is natural to expect that the great majority of cases will occur in the third and fourth months of gestation. The reason for this occurrence seems to be the irritating effect upon the nervous system of fetal movements which begin to be felt at about that time. So far as the etiology of chorea in pregnancy is concerned, acute rheumatism is the most immediate cause, and next comes an hereditary history of distinct rheumatic taint. Epilepsy and other disorders of the nervous system predispose to chorea during pregnancy. Fright, emotion, and profound anemia also favor its occurrence. For the actual outbreak of chorea, however, there must be present an hysterical predisposition to nervous excitability, a depreciated condition of the blood, and an actively exciting cause, which is usually found in fetal movements. Post-mortem examinations of patients who have died from chorea during pregnancy show that in severe cases the motor cortex, the intellectual centres, and the spinal cord are all involved. In mild cases the motor cortex only is implicated, and the spinal cord least often.

The effect which chorea produces upon pregnancy depends entirely upon its severity. In mild cases amenable to treatment the pregnancy is not interrupted, while in severe cases abortion occurs, sometimes followed by fatal termination from coma and high temperature. Severe cases of chorea which do not result fatally may end in mania persisting for a considerable time. Paralysis and delirium are also occasionally observed to follow this disorder. If the pregnancy is at term when the mother is attacked by chorea, the risk to the child is but very little, if any, increased. The earlier in pregnancy that chorea occurs, the greater is the danger to the existence of the fetus. Although the physician naturally hopes that choreic movements will cease after delivery, such is rarely the case; they die away very gradually, and they have been

observed to continue for five months after labor. Pregnancy predisposes greatly to the recurrence of chorea, so that a girl who has been choreic in early life will almost surely again become choreic should pregnancy occur. As in the non-pregnant, chorea during pregnancy is sometimes more severe than a former attack, and, again, may be less violent. Choreia during childhood is very apt to reappear in subsequent pregnancies in the same individual. It is also interesting to note that the younger the patient, the greater is her liability to a recurrence of chorea.

The great liability of pregnant patients to hysterical manifestations results to a very perplexing degree in introducing this element into cases of chorea during pregnancy. The differential diagnosis is best made from the character of the movements, which in hysteria are more sudden and occasionally are rhythmical in character. Impairment of sensibility is noted as a prominent symptom in cases possessing a strong hysterical element. A history of previous hysteria is sometimes obtainable. In making a differential diagnosis imitation movements must be borne in mind, as they are sometimes calculated to deceive skilled observers. As regards the portion of the body most often affected by choreic movements, Gowers¹⁰⁸ out of 64 cases found eleven in which the right side only was affected, and thirteen in which the left side alone was affected. During pregnancy chorea is most often bilateral, the reason for this being that as the disease is more severe than in the non-pregnant, its manifestations are more widespread. It is usually found in these cases that in the beginning the movements were unilateral, afterward becoming bilateral as the disorder increased in severity. The physiognomy of the pregnant patient suffering from chorea is characteristic, being listless and vacant in expression, and when the facial muscles are affected peculiar grimaces resulting. General relaxation of the muscular system often occurs early in the disease, and in the later stages mental apathy is not infrequent. Dilated pupils are often present, and are thought to depend upon a generally relaxed condition of the muscular system. In a large number of cases the face is affected; in a few, however, it is not. Speech and the movements of the tongue become involved in the severe cases. Sighing and irregular respiration have been described by Romberg and others. It is interesting to note that chorea more severely involves the memory of pregnant patients than of non-pregnant. The cessation of choreic movements is promptly followed by improvement in memory. Patients who become maniacal after chorea often give utterance to a peculiar cry described by Romberg and others. The analogy between the cry of chorea and that of the patient about to be seized by an epileptic paroxysm is interesting. The prognosis of mania or delusions complicating chorea in pregnancy is often unfavorable; should the patient not have chorea after her delivery, she may be found the victim of delusions or of chronic mental apathy.

Symptoms of chorea especially referable to the pregnant state are, first in importance, those produced by the quickening of the fetus. The presence of a nervous temperament in a choreic patient, or its absence, will determine the

severity of the symptoms. As regards the influence of chorea upon labor, choreic movements often cease when labor-pains set in; such movements generally die away during the stage of uterine contraction, often to recur so soon as the labor-pain is over. The labors themselves are often normal, and in many cases during the pains, especially when the patient endeavors to assist them, the choreic movements become more than usually pronounced. While there is a temporary lull in the choreic movements after the birth of the child, the effort to expel the placenta is usually followed by their exacerbation. It occasionally happens that choreic movements become more than usually increased during the puerperal state about the third or the fourth day. The irritation incident to the formation of milk has been cited to explain this fact. Abdominal pain, which often accompanies movements of the bowels at this time, is also thought to cause increased choreic movements. Pressure on the uterus and the abdomen sometimes increases choreic movements during the puerperal state. The irritation of nursing their children has aggravated chorea in some patients, the convulsions becoming so violent that the nipple was jerked out of the child's mouth.

In choreic cases endocarditis is sometimes observed as a complication, and it makes the prognosis much more serious. Hemic murmurs dependent upon anemia are exceedingly common in these patients. An examination of the urine shows an excess of urea and phosphates, probably the result of the increased muscular activity of the convulsive seizures. In diagnosis the chief difficulty arises in distinguishing the true chorea of pregnancy from the hysterical and mixed forms. Attention may again be called to the fact that in true chorea movements are irregular and spasmodic, and are increased by motion and voluntary effort, especially if such effort be sustained. In the hysterical form movements are sudden, isolated, and often rhythmical especially in the fingers. Hysterical chorea never becomes so intense as greatly to exhaust the patient. Delirium, acute mania, and delusions may complicate chorea during pregnancy, as illustrated in the cases described by Jones;¹⁰⁹ one of his cases was complicated by septic infection following premature birth of a decomposed fetus at seven months. In another case paralysis of the left arm occurred as a complication. Children born of choreic mothers sometimes show marked tendency to convulsive movements. Bué¹¹⁰ describes two cases in which the chorea of the mother reappeared in convulsive movements of the child. Maniacal chorea is to be distinguished from the mania of pregnancy and the puerperal state by a previous history of choreiform movements. In default of such history an exact diagnosis is often difficult. In maniacal chorea the patients are less sullen and are more garrulous than in true mania. In estimating the dangers of chorea in pregnancy the violence of choreic movements, the amount of sleep lost in consequence, and the intercurrent complications must all be considered. The prognosis of maniacal chorea is usually good as regards the mental condition. Occasionally mental defect persists for a long time after labor, and it may ultimately become permanent. Septicemia and pyemia very seriously complicate such cases.

So far as *treatment* is concerned, sedatives and narcotics have been used extensively with but indifferent success. The indications for treatment are to secure bodily and mental rest, to procure sleep, and to bring about an improved condition of the patient's blood and nutrition. It is often necessary to protect the patient's skin from friction caused by the severity of the movements. A profoundly depressed mind and nervous system call for an entire change of surroundings. In the medication of these cases arsenic, intelligent feeding, and the maintenance of proper digestion are of the greatest importance. Rest in bed, freedom from annoyance and excitement, bathing, and gentle friction are also of value. To procure sleep, chloral in doses of 30 to 40 grains has given good results. Gairdner¹¹¹ relates the case of a girl, eight years of age, who took by mistake 60 instead of 20 grains of chloral to procure sleep; she recovered from the drug, and was permanently cured of her chorea by the dose she had taken. Trousseau and Gowers have used in these cases strychnia, pushed to a physiological effect. Sodium salicylate, wet packing, and the application of cold to the spine have also been recommended. So far as the obstetric treatment of these cases goes, the obstetrician must guard against hemorrhage, to which the anemia so generally present predisposes. Violent choreic movements also render it difficult to control the uterus during the third stage of labor. The debilitated condition of the patients exposes them to additional risk of septic infection. When chorea persists after delivery nursing should be prohibited, as it undoubtedly tends to aggravate the condition. If the chorea be slight or of the hysterical form, the pregnancy should not be interrupted. In all severe cases, however, labor should be induced. The following conditions may be cited as calling decidedly for the interruption of pregnancy in a choreic pregnant patient: threatened exhaustion on the part of the mother from the intensity of the movements and a deficiency of sleep; when mania or fixed and dangerous delusions are present; when a grave physical complication, such as endocarditis, increases the gravity of the case.

Pantzer¹¹² reports the case of a woman, aged twenty-six years, pregnant for the fifth time and suffering severely from chorea. In a previous pregnancy her movements had been so excessive that labor was induced, after which choreic movements persisted for several weeks. During the pregnancy in question she was obliged to enter a hospital. Although easily excited, she was readily controlled by morphia, and no grave condition was found at confinement threatening the interest of her child or herself. The usual treatment for chorea was administered, with the added precaution of avoiding large doses of bromid, which tend to favor hemorrhage after labor. The patient's labor was normal, and she made a good recovery.

Catalepsy is occasionally observed during the pregnant state, as in a case recently reported by Shoot of Lunwarden.¹¹³ The patient was a robust woman, aged forty-four, who had borne eleven children; in youth she had suffered from typhus, and after recovery became subject to fainting fits, but throughout her married life she remained strong and well. There was no history of a neurosis in her family. During the seventh month of her twelfth

pregnancy she was seized with cataleptic fits following the loss of a child: she was found stiff and motionless by the attending physician. The forearm could be raised and bent with some force, and remained in the same position for about ten minutes, after which it slowly fell. The lower extremities behaved in a similar manner. Consciousness was lost. The pulse was 64, full and regular, the temperature and respiration normal. The pupils were somewhat dilated, but reacted to light. On inhaling chloroform the rigidity of the muscles disappeared, and the patient seemed to sleep calmly for hours. On awakening the patient remembered nothing that had taken place. The fetal heart-sounds, previously audible, were lost, and were not heard until fourteen days before labor. No albumin was found in the urine upon examination. Cataleptic fits occurred three or four times daily, occasionally with an interval of several days. Atropin gave the patient a week's freedom; the disorder continued, however, to term, when she was safely delivered of an apparently healthy boy. On the fifth day after labor an attack recurred while the patient was nursing her child; two days later the second took place, which was the last. Shortly after the first attack her child, who had been weaned because of the cataleptic complication, was seized with dysphagia. In the evening of the same day the child had a cataleptic fit, the symptoms being precisely those of the mother. The rigidity which developed relaxed during a warm bath, but soon afterward returned. Tonic cataleptic convulsions recurred, and the child died after two days' duration of the cataleptic fits.

Pregnant patients are exposed to those poisonings of the nervous system from lead, arsenic, dyestuffs, tobacco, and other substances met with in the arts, and which commonly act by producing, among other complications, multiple neuritis. In the absence of specific poisons multiple neuritis is occasionally observed, as described by Solowieff.¹¹⁴ His patient was three months advanced in pregnancy and suffering from nausea and vomiting. No cause for the latter complication could be found in the condition of the urine or of the genital tract. Her nervous symptoms, however, were peculiar and pointed to multiple neuritis, especially well marked in the lower extremities and upon the back and neck. The organs of the special senses were in a very hyperesthetic condition; the blood was normal. Her history included an attack of scarlatina in childhood, and also hysteria. She was nourished, when necessary, by rectal injections, and was treated by faradization and hypnotism. A very careful study of her nervous system showed polyneuritis in very widespread degree. A post-mortem examination showed all the viscera free from marked pathological change. The nerve-trunks, however, throughout the body gave evidence of varying degrees of degeneration; this was especially true of the phrenic nerves: it had been noticed during life that the action of the patient's diaphragm was at times very deficient.

Diabetes.—Among the rare disorders of pregnancy in which the nervous system and the assimilation of the patient seem equally affected may be considered diabetes. Its rarity may be inferred from the statement of Griesinger,

who found, of 53 cases among women, two only during pregnancy. In Frerichs' large experience, in 386 cases there were 104 among women, and only one of these had diabetes during pregnancy. Matthews Duncan¹¹⁵ reports the case of a multigravida who had a suspicion of diabetes for a short time in a former pregnancy. At the eighth month her fetus perished *in utero*. Excessive amniotic liquid was present. The patient collapsed before labor began, and perished shortly after. During her first pregnancy she had suffered from great thirst, and passed enormous quantities of urine during the first few days after delivery. During the pregnancy which ended fatally her urine was examined two months before her confinement, and nothing abnormal was detected. It was excessive in quantity. The patient's tongue was dry and brown, her breath had a peculiar sweetish odor, and purplish areas were detected upon the skin. Her temperature was normal, but she suffered greatly from a sensation of oppression. Reid reports a case very similar to Duncan's. The amniotic liquid was very abundant, and it possessed an abnormally great amount of albumin. The child was large and well developed, but dead before labor. Newman saw diabetes in two pregnancies in the same patient, the mother finally perishing of the disease. Lecorchi observed diabetes in an infant born of a diabetic mother. Williams reports a case, with autopsy, in which the liver and kidneys were found granular and in pale cloudy swelling. In Husband's case the liquor amnii was saccharine. Bennewitz and Winkel also report cases. In Duncan's case an examination of the eyes revealed a large pear-shaped clot in the central spot of the retina. The patient was suddenly taken with intense pain in the right side of the abdomen in the fifth month of pregnancy. Labor was induced, but the child was dead and decomposed. The patient died, and no cause for the fatal issue could be found on post-mortem examination. Frerichs discovered in a patient, in the eighth month of pregnancy, who suffered from diabetes and who perished after delivery, a tumor of the medulla oblongata. Diabetes may occur during pregnancy only, being absent at other times. It may cease with the termination of pregnancy and may recur afterward. The prognosis for subsequent pregnancies is not invariably bad, as a patient, if cured of diabetes, may in subsequent pregnancy escape its return. The existence of diabetes does not militate against conception.

A possible explanation of the occurrence of diabetes during pregnancy is found in the results of the study made by Oldi and Vicarelli:¹¹⁶ these observers found that during pregnancy there is a largely increased consumption of hydrocarbons derived from the waste of nitrogenous material resulting from fetal nutrition and growth. This was seen by analyzing the air respired by pregnant patients. It is rational to conclude that cases in which this metabolism is seriously disturbed may furnish the complication of diabetes during pregnancy.

Diabetes seems almost uniformly fatal to the fetus, and that at a comparatively early period of gestation. The amnion seems to be the seat of the diabetic process, and dropsy of the amnion or the formation of saccharine

matter in the amniotic liquid is the condition most commonly observed. Fry¹¹⁷ reports the case of a patient in her second pregnancy who suffered from great thirst and who was easily fatigued. Examination of the urine showed 9 per cent. of sugar, which was reduced by treatment to 5 per cent. The child perished during pregnancy. The mother died five days after delivery.

The treatment of diabetes complicating pregnancy is that which the practice of medicine enjoins in such cases. The fact that the life of the fetus is usually lost should lead the obstetrician to disregard it, and to empty the uterus promptly if the diabetic condition is pronounced. The *prognosis* for the mother, should she survive labor or abortion, is unfavorable, as the diabetic condition commonly persists and ultimately proves fatal. The fact that diabetes occurs in pregnancy, and that it is attended with peculiar fatality, emphasizes the necessity for the examination of the urine in pregnant patients. The presence of more than a trace of sugar should lead to a thorough examination of the patient's processes of assimilation, when it may be possible to avert further development of diabetes, and thus save the lives of mother and child.

The pathology of diabetes mellitus complicating pregnancy is well illustrated by a case reported by Hehir.¹¹⁸ The patient, a multigravida, suffered from diabetes during pregnancy, and gave birth to a dead fetus nearly at term. Amniotic liquid was turbid, having a heavy, mawkish odor, and being very abundant. An infusion was made from the epidermis of the fetus, and traces of sugar found in this infusion. The liquor amnii was also examined, and in it sugar was found. The patient had been greatly annoyed during her pregnancy by excessive corpulence, and had suffered from polyuria and diabetes mellitus. Hehir also describes a case of diabetes in pregnancy in which abortion occurred at the fifth month; similar phenomena were observed in this case.

Idiopathic universal pruritus as a complication of pregnancy may occasion great distress and may seriously interfere with a patient's rest and nutrition. In two cases reported by Feinberg¹¹⁹ the disorder became worst at the time when menstruation would have occurred had pregnancy not been present. Palliative treatment mitigated the patient's sufferings to some extent, but it was unsuccessful in relieving the disorder. Both patients were exceedingly nervous, easily excited, and one of them aborted under great excitement.

Pruritus limited to the vulva and vagina is frequently observed as a complication in patients suffering from diabetes during pregnancy. In such cases any form of *treatment* which lessens the amount of sugar in the urine decreases the patient's suffering from pruritus. In cases not associated with diabetes local applications are indicated, such as antiseptics, in strong solution, painted over the part. Thus, bichlorid of mercury (1:1000) followed by an application of salt-solution or plain water, carbolic acid, 3 to 5 per cent., tincture of iodine, glycerin, and carbolic acid, are often employed. In patients not unduly susceptible cocaine is used to advantage, although the extensive area to which the application must be made renders it a dangerous one to patients readily influenced by the drug. The application of electricity by placing a

moist electrode upon the mucous membrane of the vulva has been beneficial in some cases. The observance of cleanliness is of great importance, especially where a vaginal discharge annoys the pregnant patient. Douches of carbolic-acid solution, of creolin and green soap, of boracic acid, of alum in solution, or of a hot solution of sodium bicarbonate should be tried faithfully. Sitz-baths of a warm solution of boracic acid, of sodium bicarbonate, or bran sitz-baths are also indicated. The local application of starch and laudanum or lead-water and laudanum is another resource of service. Where extensive irritation and excoriation are present the application of an ointment containing belladonna, opium, and iodoform is often a source of great comfort. Pencilling the mucous membrane with nitrate of silver is occasionally of value. In the majority of cases, however, the best treatment for pruritus of the vulva and the vagina complicating pregnancy is to be found in careful cleansing, effected by gentle irrigation of the parts with non-irritating, antiseptic fluids, and by constitutional treatment addressed to improving the condition of the patient's nervous system and assimilation.

Hysteria during pregnancy furnishes an interesting illustration of the fact that the pregnant condition exaggerates any previous defect or susceptible point in the patient's mental and physical organization. The belief once entertained that pregnancy exercises a favorable influence upon women already hysterical is certainly erroneous. It occasionally happens that a pregnancy, greatly desired and occurring amid the most favorable circumstances, furnishes a healthy stimulus and assists a patient in cultivating self-control, but such cases are the exception and not the rule. Mild forms of hysteria during pregnancy often take the shape of melancholia and fear of approaching confinement. Such cases require patient encouragement on the part of friends and physician, and should stimulate the obstetrician to take every precaution that he be surprised by no unforeseen complication during the labor. If the physician makes a thorough study of his patient before labor, and demonstrates to her that he has exercised every precaution in her behalf, it will go far in allaying her apprehensions. In the experience of the writer preliminary examination of pregnant patients by palpation, auscultation, and pelvimetry often exercises a very favorable influence in such cases. Hysteria complicating pregnancy becomes dangerous when it passes into a condition of maniacal excitement. While the prognosis in such cases is not unfavorable so far as the recovery of the mother goes, yet these patients require prolonged and careful treatment, and should labor occur during mania injury to the fetus or to the mother may result. Such cases require constant watchfulness, kind and systematic restraint, and when any obstetric manipulation is required the use of anesthetics is usually a necessity. As one of the dangers that threaten in these cases is exhaustion through a refusal to take food, feeding of such patients is a cardinal point in their treatment. As is so often seen in dealing with the insane, it is better to attempt no deceit in their management, but to win the patient's confidence by faithful and patient attention without dissimulation.

Mania complicating pregnancy is of importance chiefly as influencing the course of labor and the puerperal state. Mania is observed during pregnancy in patients of very neurotic organization, in those having a heredity of insanity, in women who have been alcoholic, hysterical, or in other ways neurotic, and in women who suffer some great mental shock while in the pregnant condition. Unhappy marriages form a considerable element in the causation of mania during pregnancy. The diagnosis in these cases is to be made by eliminating hysteria, delirium tremens, hystero-epilepsy, and the temporary delusions and hallucinations which sometimes accompany toxemia from deficient excretion. In the former, observation will usually make differential diagnosis a matter of ready accomplishment. In cases of toxemia a study of the patient's excretions is required to arrive at a correct result. The prognosis in these cases depends upon the underlying condition which is the exciting cause of the mania. In those of highly neurotic organization, but whose physical condition is good, the prognosis for life is good, but the outlook for mental soundness is not brilliant. In cases where mania has followed a profound shock, as by sudden bereavement, an accident, or a calamity, if the patient's physical condition is good the prognosis for a complete recovery is also good; this is especially true if the child is carried to term and survives its birth. If, however, mania is grafted upon a background of serious physical disability where some well-marked pathological condition is present, it may be the forerunner of a fatal issue—if not at labor, within a short time afterward. This is especially true in those cases where toxemia and interstitial nephritis are beginning, and where the patient, if she escapes eclampsia, passes into a condition of pronounced and fatal nephritis after labor.

The treatment of mania during pregnancy varies with the condition which excites the mania. What has been said regarding the treatment of hysterical mania applies to cases where the patient is neurotic, but is physically in good condition. In women who become maniacal in the presence of calamities or of sudden bereavement the free use of narcotics for a time is often indicated to secure sleep. If the life of the child continues, the hope of its birth and maternal affection should be used as powerful mental tonics in dealing with the mother. Perfect seclusion and protection from all intrusion are absolutely essential. When the first shock to the mind and the nervous system has passed, all the resources of the therapeutic art are required in promoting the nutrition of the brain and nervous system. The treatment of mania complicated by toxemia through deficient excretion calls for the avoidance of narcotics and sedatives and the prompt securing of active elimination. As soon as the patient is freed from the poisons which are irritating the brain her condition usually is markedly improved.

Nausea and Vomiting of Pregnancy.—On the border-line between the physiology and the pathology of pregnancy, nausea and vomiting have been considered by some as an inevitable result from the irritation occasioned by the development of the pregnant uterus, and by others as purely a pathological phenomenon. Like the kidney of pregnancy, the pregnant uterus and its

nervous supply are in a condition of plethora which borders upon an actual pathological change. The progress of our knowledge in the pathology of pregnancy gives good reason at present for the belief that nausea and vomiting are not a physiological, but a pathological, accompaniment of the pregnant condition. As many patients pass through pregnancy with no pathological lesion of the kidneys, so many women bear children without the nervous irritation and the anemia, slight or profound, that accompany nausea and vomiting.

The predisposing causes for the emesis of pregnancy are to be found in a congenital irritability of the nervous system, that produces exaggerated response to normal reflex stimuli. The predisposing causes for this affection are anatomical lesions in the generative tract, notably congenital malformation of the uterus or dislocation of the pregnant womb. The exciting causes for this complication are sudden shocks to the nervous system that powerfully exaggerate its reflex susceptibility. An infective process producing hyperemia and irritability of the cerebro-spinal axis may also be an exciting cause for the nausea and vomiting of pregnancy. A pathological process which affects the constitution of the blood is also a frequent exciting cause in these cases. Direct mechanical injury or violence to the pregnant womb often begins and maintains this condition; thus, a patient in early pregnancy, while straining or lifting, suddenly retroverts the uterus, and obstinate emesis follows. Metallic and irritant poisons absorbed into the system, vitiating the blood and irritating the nervous centres, produce nausea and vomiting. Among the most frequent of the exciting causes are the movements of the fetus *in utero* and excessive peristalsis in the mother's intestine. Distention of the bladder and the rectum is frequently present in these cases.

The diagnosis of this condition must usually be made in large part from the statements of the patient or from those of her attendant. As such vomiting is most frequent in early morning, unless in severe cases the physician rarely has an opportunity actually to observe the phenomenon. In mild cases nausea begins as soon as the patient raises her head from the pillow. The desire is for instant emesis, which is usually accomplished without straining, and is often repeated. Following this emesis the patient may take food with appetite, and the phenomenon may not recur until the next morning. In such cases the matter vomited is mucus, sometimes of strongly acid reaction, sometimes of neutral reaction. In more severe cases the sensation of nausea begins as soon as the patient awakes; assuming the upright posture is followed by vomiting but little relieved by emesis. The material ejected is mucus, often burning and bitter to the taste, frequently excessively sour. Although the patient may succeed in retaining food, the sensation of nausea persists often until mid-day or even later: the sight or the presence of certain articles of food greatly increases her distress. Perturbation of any kind exaggerates the sensation of nausea. If vomiting is repeated, it is accompanied by straining and retching. After mid-day the patient is better, and may eat heartily at evening. Such cases are accompanied by anemia and often by considerable loss of weight. A third class of cases is well characterized by the term *per-*

nicious; in them the sensation of nausea is present at intervals during the patient's waking hours. Her cravings are for varied articles of food and drink, and they are no sooner satisfied than a new craving arises. Vomiting is accompanied by straining and retching, by dryness of the fauces, or by profuse salivation. The matter ejected is, first, mucus and the food taken, bile, and, in severe cases, mucus stained with blood or with coffee-ground material. Food is no sooner swallowed than it is ejected, although there occur surprising periods of tolerance in which the patient eats greedily, and which occasion hope in the mind of the physician that substantial improvement has taken place. As the case proceeds distress and pain are felt beneath the sternum, not located at any fixed point. The sensation is described sometimes as that of smothering, but more often as that of distress which has nothing to do with breathing. In dangerous cases it is worst at night. Emaciation is progressive—in some cases rapid, in other cases slow. A more deceptive phenomenon in these patients is acute fatty degeneration of the tissues, that gives to the patient a plump appearance which may deceive the physician. As the case progresses the clinical picture of pernicious anemia becomes more and more apparent. Signs are present of disintegration of the blood in the vomit, in hematogenic jaundice, in sordes, and in purpuric extravasations. The urine contains the *débris* of broken-down corpuscles, the feces are dark in color, the mucous membranes dark and reddish in appearance, and the mental condition is one of apathy or of delusion so often seen in these cases. A further explanation of the process is observed in the condition of the eyes by a necrosis of the cornea, and dimness of vision may be noted. The pulse and the cardiac action of the patient in severe cases of nausea and vomiting of pregnancy show the effect upon the heart and the arteries of the gradually developing anemia. The pulse is rapid, soft, and weak. Arterial tension is usually diminished, the first sound of the heart grows less and less distinct and forcible, and in fatal cases cardiac syncope develops. The temperature is subnormal at first; later in severe cases it increases as a fatal issue approaches. In other cases the temperature varies slightly from the normal, and in all cases it is not an important factor in diagnosis or in prognosis. The pulmonary signs are usually negative: the patient occasionally complains of an irritable cough which accompanies a dry condition of the fauces, or in others of the accumulation of an excessive amount of mucus. Palpation of the abdomen may detect a dislocation of the uterus, and in the early stages of the more severe cases the abdominal walls are often excessively irritable, the practice of palpation increasing the nausea. Liver-dulness is usually slightly increased in area as the liver becomes the seat of acute parenchymatous, fatty degeneration. The patient's reflexes are much increased, although paralysis or atrophy, other than that attending emaciation, is seldom observed. The nutrition of the skin, except in purpuric cases, is usually fairly maintained; bed-sores in cases well cared for are of rare occurrence. A clammy sweat is frequently seen, especially upon the face.

The symptoms of an improvement in the condition of the patient suffering

from nausea and vomiting of pregnancy are a diminution in the nausea and the emesis; the ability to take and to retain food; a normal condition of the excretions, especially of the urine; the absence or the diminution of excessive perspiration; considerable periods of sleep without emesis, and the absence of substernal distress, especially at night. The pulse falls gradually to 100, and the temperature remains normal. Symptoms of danger in these cases are the continuance of the nausea and vomiting and the gradual development of the signs and symptoms of pernicious anemia. Among the most important of these are a persistently rapid, feeble pulse, substernal pain and distress, and coffee-ground vomit.

The *pathological anatomy* of these cases may be divided into—first, those of the organs of the body other than the generative organs; and, second, those of the uterus and its appendages. In the first class of cases it is evident that lesions which may produce obstinate nausea and vomiting in the non-pregnant may also by coincidence be present in gravid women. Thus, cancer of the stomach; chronic gastritis, whether gouty, alcoholic, or caused by arterio-sclerosis; nephritis in its various forms; brain-tumor; chronic displacement of the stomach by the pathological condition of adjacent viscera; hysteria producing emesis; emaciation, vomiting, and acute yellow atrophy of the liver,—may be present and cause vomiting in pregnant patients. Of these conditions but one stands in a possible causal relationship, and is by some considered dependent upon the condition of pregnancy. It has been shown by Lomer and by Frerichs that this disorder may affect pregnant women in forms of varying severity, and that the milder cases of acute yellow atrophy of the liver, in which death does not occur from this complication, often show themselves through nausea and vomiting only.

As regards the changes to be met with in the genital organs in these cases, they are, first, those of position; and, second, those of structure. In the former we have acute and chronic dislocations of the uterus. Commonest among these dislocations is retroversion, which generally follows straining or lifting, and in which the relation between the dislocation and the nausea and vomiting is that of evident cause and effect. This complication is serious in proportion to the condition of the surrounding parts: if no adhesions bind

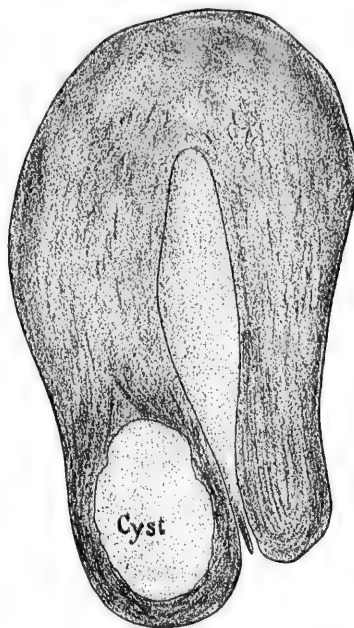


FIG. 144.—Vomiting of pregnancy. Cyst in anterior wall of cervix (Davis).

the uterus in its abnormal position, the reduction of the dislocation is readily effected and the exciting cause is at once removed. Where, however, the pregnant womb becomes retroverted and bound down by adhesions in the process of pelvic inflammation, the pathological condition is far more complicated and grave. Chronic dislocations of the pregnant womb are those in which that organ as a whole is forced downward in the pelvis and impacted with its fundus against the symphysis pubis. This condition of the womb is the result of persistent wearing of tight clothing before and after the occurrence of pregnancy, and it has been well described and its importance has been urged by Grailey Hewitt in a brochure entitled *Severe Vomiting during Pregnancy*, published in London in 1890. This condition of impaction is not infrequently accompanied by congenital malformation of the pregnant uterus, evidenced by extreme antelexion, with a pathological condition of great importance in the cervix. It has repeatedly been observed in such cases that the cervical canal was tightly closed and that the tissues of the cervix were excessively dense and resistant. Attention has recently been called by Davis,¹²⁰ in a case of this sort, to a condition of excessive development of connective tissue in the cervix accompanied by the presence of a retention-cyst of considerable size in the anterior wall of the cervix (Figs. 144, 145).

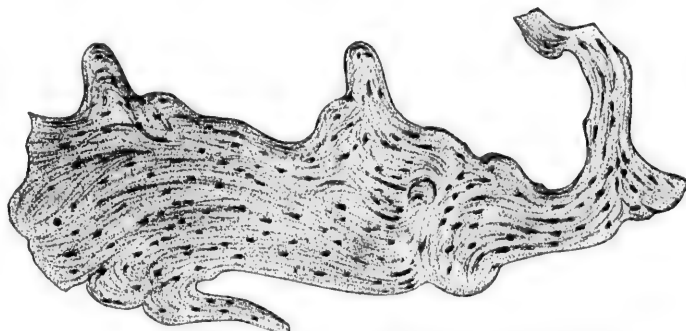


FIG. 145.—Vomiting of pregnancy. Dense connective tissue in cervix (Davis).

In addition to these gross changes in the uterus, tumors of the ovary and enlargement of the tubes have been observed in cases of nausea and vomiting of pregnancy. Microscopic examination of the endometrium in many of these cases has demonstrated the presence of endometritis of various forms: that this of itself is a cause of the nausea and vomiting is not demonstrated; the condition is apparently the accompaniment and the result of the congenital malformations or dislocations already described.

Through the researches of Lindenmann of Moscow¹²¹ we are in possession of the interesting results of microscopic examinations upon the tissues of a mother and her fetus perishing from pernicious vomiting complicated by polyneuritis. A gross examination revealed enlargement of the spleen with the appearance usual in inanition, with cirrhotic kidneys and liver. Micro-

scopic examination revealed neuritis of the phrenic, pneumogastric, median, and peroneal nerves, being especially well marked in the phrenic. The liver showed fatty degeneration and cloudy swelling. The blood-vessels of the spleen were dilated, and the blood-corpuscles could not be stained by coloring agents. The epithelium of the kidneys showed fatty degeneration. The organs of the fetus exhibited fatty degeneration of the liver and necrosis of the kidney. The entire pathological picture was that of infection by a toxine, and Lindenmann considers the infection as auto-intoxication. In his control-experiments upon this case he describes interesting observations on the pathology of inanition in animals, and from these comparative studies he excludes simple inanition as a cause for the lesions in pernicious nausea.

The rational *treatment* of the nausea and vomiting of pregnancy is impossible without a thorough knowledge of the condition, first, of the patient's processes of assimilation, and, second, of the condition of the genital tract. The patient must be examined thoroughly to exclude any cause for the malady that lies outside the genital tract. This examination will eliminate the rarer complications of this disorder. A thorough and painstaking examination of the uterus, its size, shape, consistence, position, and the condition of the pelvic tissues surrounding it, is then imperative. In cases where the sensitiveness of the patient is so great that an examination aggravates the vomiting, anesthesia by chloroform or by bromid of ethyl is indicated. The physician in this examination must broadly differentiate between two conditions: he may find a simple dislocation of the uterus in retroversion or prolapse of the uterus, and partial impaction anteriorly; or he may detect a congenital malformation manifested in sharp ante flexion with thick and resisting cervix, or a retroversion bound down by pelvic adhesions. In the first and simplest of these conditions the restoration of the uterus to its normal position is indicated, and is almost invariably successful in relieving the condition. The explanation of this relief seems to be that the constant irritation to the reflex nervous system which pressure upon the pelvic nerves maintains is relieved by replacing the uterus, hence the pathological phenomenon ceases. If retroversion be present, the bladder and the rectum should be emptied thoroughly, the patient placed preferably in Sims' position, when, under anesthesia if necessary, the perineum should be retracted and the cervix drawn downward and backward with one hand, while with the fingers of the other hand the fundus should be directed gently upward and forward. Reposition having thus been effected, it is well to sustain the uterus in its position, at first by a packing of antiseptic gauze, then by tampons of carded wool. If the pregnancy be an early one and no pathological condition in the pelvis be present, a Hodge pessary may be worn to advantage. In prolapse and anterior impaction of the gravid uterus a thorough emptying of the bowel is of great importance before attempting replacement. The uterus should then be raised gently upon the fingers of the physician, and if difficulty and resistance be experienced, the knee-chest position should be tried. It is often observed in these cases that but slight change in position is sufficient to relieve the patient, and this

gain, however small, is to be maintained by tamponing the vagina with antiseptic soft material. As soon as the patient's strength permits, if the uterus is not in its normal position, it should again be raised by gentle manipulation and the tampon be replaced. In this manner, under thorough antiseptic precautions, it is possible by gentle manipulation to restore very nearly to its normal position a uterus prolapsed and anteriorly impacted.

In cases where the physician detects an abnormal condition of the cervix, the result of congenital malformation and pathological processes, the case is far more serious and the treatment is more difficult. It is here that dilatation of the cervix, found by Copeman,¹²² by a fortunate accident, to be efficient, is the method of treatment to be employed. The profession is familiar with Copeman's effort to induce labor in a patient pregnant six months and almost dead from nausea and vomiting. Having dilated the cervix as much as he could with his fingers, he attempted to rupture the membranes and failed. The improvement caused by the dilatation was so great that no further interference was practised, and the patient recovered. There can be no question but that in cases where a pathological condition of the cervix is present, dilatation is demanded, and without delay. The physician should not be misled by a soft condition of the external os, for oftentimes a chronically congested mucous membrane and hypersecretion of the glands of the cervix give to the casual observer the impression that the cervix is softened. While this may be true of its external portion, the internal os will be found tightly contracted and its walls in a condition of dense resistance. Dilatation should be practised under anesthesia, preferably by chloroform or by bromid of ethyl. The finger is a safe instrument, but in cases where the tissue resists the finger it is necessary to use, first, steel-bladed dilators, as is done by Wiley and others, and then complete the dilatation to the point of admitting the finger by solid metal bougies. This procedure of course exposes the pregnancy to danger of interruption, and rupture of the membranes may occur during the dilatation. The physician should be prepared for this complication by having ready a suitable curette and douche-tube with which to thoroughly curette and douche the uterus. Following the complete removal of the ovum by the curette and douche, the uterus should be packed with iodoform gauze and be carried well up into the pelvis. In undertaking to treat a case of the nausea and vomiting of pregnancy it is impossible for the physician to do his duty without making a thorough examination, and without practising interference such as his judgment may dictate. If he is hampered in this examination by the prejudices of his patient, he must decide whether to place the responsibility upon her and her friends or to retire from the case.

In milder cases, where a condition of simple irritability and hypersecretion in the os and cervix are detected, local applications to these parts are of great value. Where the mucous membrane is angry and red, following a cleansing douche of creolin and green soap, the physician may apply nitrate of silver by pencil with advantage. In raising a simply dislocated uterus in the pelvis antiseptic and analgesic ointments may be incorporated with the tampons employed.

Thus an ointment of belladonna, iodoform, and morphia is sometimes of use in these cases. If excessive secretion be present, iodoform, belladonna, and glycerol of tannin form a useful mixture.

The medicinal treatment of the nausea and vomiting of pregnancy consists, first, in eliminating by examination the necessity for operative interference, or in promptly remedying a pathological condition of the uterus. A strict control of the patient is then an absolute necessity, and here the services of a skilled and competent attendant are of the greatest value. The patient should be put to bed and her strength preserved in every possible way. The subject of nausea and vomiting should not be dwelt upon with her. She should be fed by carefully-prepared nutriment—if possible, by the mouth—at regular intervals. If the stomach is non-retentive, rectal injections of nutritive substances are demanded. Among these substances are various preparations of beef in the form of peptonoids, peptonized beef, beef-juice combined with brandy, with milk peptonized and pancreatized. If it is desired to administer alcohol and the stomach cannot tolerate dry champagne or brandy and soda, brandy may be given by rectal injection. The list of remedies which have been employed by administration in the stomach in these cases is excessively great, and it shows how comparatively unimportant all have been in radically relieving the disorder. Where evidence of chronic catarrh of the stomach was present, lavage of the stomach has been found of the greatest value. The soft-rubber stomach-tube should be passed, and a solution of sodium chlorid, sodium salicylate, or a dilute solution of bicarbonate of sodium should be employed. The administration of animal ferments in connection with food is also of great value. Thus, ingluvin, pancreatin with sodium bicarbonate, with nux vomica, or strychnia and pepsin, are of decided value. Solid food must not be attempted until the patient's strength has considerably improved and the condition of the tongue warrants its trial. It is well at times to consult the patient's appetite and craving when solid food is given, if this craving does not call for articles of an injurious character. When solid food is taken, scraped raw-beef sandwiches, oysters, junket, milk with lime-water or with Vichy, and freshly made broth in which bread is dipped, are usually of value.

Drugs are of use in the treatment of this complication only in so far as they assist in preserving the patient's strength. It is folly to drug a patient with narcotics while the physician is ignorant of the position and condition of the pelvic organs, and the prolonged administration of morphia is often simply a mask for negligence or for incompetence. It is much better to procure sleep by the administration of alcohol per rectum by night, by sponging with warm water and bathing whiskey, and by securing for the patient perfect repose, than by the administration of depressing remedies. Where narcotics are indispensable, morphia and atropia or codeia are undoubtedly the best. In extreme cases prompt and vigorous stimulation must be brought into play to tide the patient over a collapse which may follow the dilatation of the cervix or the emptying of the uterus. Here the hypodermic use of strychnia,

digitalis, atropia, and alcohol, the transfusion of saline solution, the application of electricity to the spine, the application of heat to the base of the brain and about the trunk of the body, are all of value.

The explanation of those cases in which spontaneous cure of this condition occurs is to be found most reasonably in spontaneous reduction of dislocations of the uterus. Experience has shown that it requires but a slight change in the position of this organ to alter a state of irritant pressure to a condition in which no irritation, or but little, is produced. There is certainly no other rational explanation, from our knowledge of pathology, for these cases. The folly of waiting for such a change to occur without using every effort to place the uterus in proper position is self-evident. It is remarkable that this most important point in treatment—namely, the securing of a proper position of the uterus—should have been considered as a last resort. That such a change may often be produced by the posture of the patient only is illustrated in a case reported by Grant,¹²³ who as a last resort elevated the hips of a patient upon pillows, whereupon her vomiting ceased. The fact that curetting the uterus in urgent cases is followed by immediate relief is well illustrated by Roland¹²⁴ and by Blanc.¹²⁵ The excellent results following the reduction of

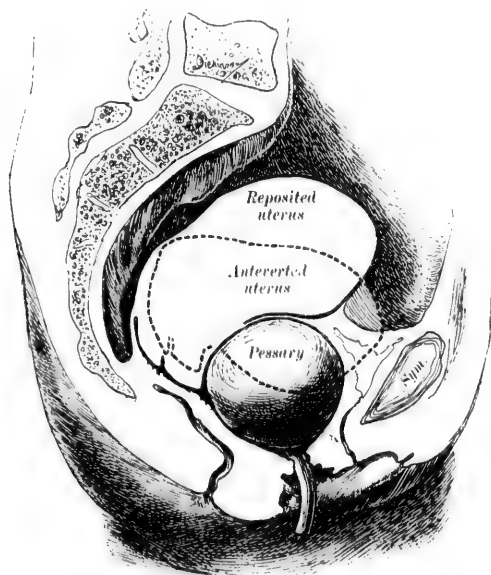


FIG. 146.—Air-ball pessary in position and raising the uterus.

dislocations of the uterus find abundant illustration in Hewitt's *Reports*, in which the use of the Gariel air-ball pessary is described and fully illustrated. This instrument is of value when the finger has dislodged the anteriorly-impacted uterus, and under antiseptic precautions its use has been attended with

excellent results. The accompanying illustration (Fig. 146) shows the air-ball pessary in position and raising the uterus in the pelvis. Kingman¹²⁶ also describes cases in which the reduction of uterine dislocations has terminated nausea and vomiting.

Ptyalism complicating this condition has been well described by Ahlfeld,¹²⁷ who believes that these cases are primarily neurotic in origin, and treats them accordingly. With the same view of the causation of vomiting, Gunther¹²⁸ treats these cases by galvanism, the positive pole being placed against the cervix, the negative between the eighth and twelfth dorsal vertebræ. From $2\frac{1}{2}$ to 5 milliampères were employed for from seven to ten minutes; so long as the current was uninterrupted he did not observe danger of disturbing the pregnancy. Säger and Hennig¹²⁹ describe cases in which the exciting cause of vomiting was a pathological condition, either in the uterus or some abdominal organ.

Ascites complicating pregnancy may arise from a lesion of the abdominal viscera interfering with the return circulation and also with the lymphatic circulation of the peritoneum. Pregnancy itself sometimes occasions ascites through a pathological condition which affects the peritoneum of the mother and the amnion of the fetus by a similar process. An interesting case illustrating this condition is reported by Florentine.¹³⁰ The patient was a young woman married three years who had borne one living child and had one abortion. The cessation of menstruation was followed by obscure pain in the abdomen, increase in size, and the evident presence of fluid. Pressure-symptoms became so pronounced that suffocation was threatened and pains like those of labor supervened. The membranes were ruptured, when the entire fetus with a large amount of amniotic liquid was suddenly expelled. Distention of the abdomen was relieved by paracentesis. The presence of an ovarian cyst was then diagnosticated and the tumor removed a month later. Recovery ensued.

Tubercular peritonitis complicating pregnancy is also a cause of ascites, and it may develop gradually as gestation advances. The treatment of abdominal dropsy complicating pregnancy is, preferably, by exploratory incision. If a tubercular process be present, the prognosis for very great improvement, if not recovery, is excellent. If a pathological condition of the lymphatic system of the peritoneum is the cause of the condition, free drainage by incision is much the safer treatment. The immunity displayed by pregnant patients to operative procedures when properly conducted renders such interference safe and highly appropriate.

Phantom pregnancy, or **pseudo-cyesis**, may result from a strong desire for pregnancy in a patient suffering from ascites. An illustrative case is reported by Clay.¹³¹ Phantom pregnancy without pathological lesion is not a rare condition. Observed in nervous patients who strongly desire pregnancy, and who are usually past the time of greatest reproductive activity, its symptoms are the subjective symptoms of normal gestation. The *diagnosis* and *treatment* of this condition are completed by a thorough examination, and

whenever the patient will submit to examination under an anesthetic the cure is usually complete. It is well in such cases to have a friend of the patient present at the examination to personally witness the disappearance of the abdominal tumor as anesthesia proceeds. Illustrative cases are found in the literature of the subject, and among them is that of Johnston.¹³²

Acute yellow atrophy of the liver in the pregnant woman is an infectious disease of uncertain origin. Out of 143 cases of this disorder Thierfelder observed thirty during pregnancy. Spæth saw it but once in 16,502 pregnant women. Epidemics of this disorder have been reported by Kerksig, Charpentier, and Bardinet. Lomer's excellent paper upon the subject, and the reports of Matthews Duncan¹³³ describe this complication fully. Its *symptoms* are those of jaundice, hematogenic and hepatogenic, with evidence of profound intoxication from the absorption of septic material and toxins. On palpating the abdomen the area of liver-dulness is diminished; after the stage of incubation, lasting from three to five days, the patient has gastric and intestinal catarrh with rigor, pains in the head and back, and fever. Albuminuria is often present; in severe cases there is great tenderness over the liver and abdomen. Occasionally the disease results in death before delivery. As a rule, patients come into labor or abort with a fatal issue. In a case recently observed by the writer the profound jaundice of the mother was reproduced in the bright yellow color of the amniotic liquid and the deep orange staining of the fetus and its appendages. This patient had high fever before delivery, and died in septic coma shortly afterward. The cause of acute yellow atrophy with malignant jaundice is blood-poisoning from acute septic infection. Its *prognosis* is exceedingly grave, and the treatment of these cases consists in the effort to terminate pregnancy promptly, to arouse the secretions of the intestinal canal, and to support the patient's strength.

The milder form of *jaundice during pregnancy* may result from impaction of feces, catarrh of the bile-ducts, pressure of the pregnant womb upon the liver, and the physiological hyperemia which the liver shares in common with other abdominal viscera. Failure in excretion by the kidneys in greater or lesser degree is often noted in these cases, and the development of gall-stones is a not infrequent accompaniment. Where the disorder is promptly recognized, and the gastro-intestinal tract is subjected to proper and efficient treatment, it is often possible to avoid fatal issue. Winter describes an illustrative case¹³⁴ in which a multigravida who had suffered from malarial intoxication was attacked with jaundice. After a violent illness of six or eight days, with great gastric disturbance and vomiting, premature labor occurred, after which the mother recovered. The *treatment* of this condition is the medicinal treatment appropriate for these cases in the non-pregnant. Premature labor is to be expected in well-marked cases, and in protecting the interests of the mother no effort should be made to avoid it.

Gastric ulcer complicating pregnancy has been observed by Robert Koch¹³⁵ in two patients, each of whom suffered from profuse vomiting of blood accompanied by abdominal distress. In one, the milder case, pregnancy was inter-

rupted and a living child was born. In the other the patient collapsed after vomiting blood freely, and, although she rallied and ultimately recovered, her child was stillborn.

Appendicitis in pregnancy has been well described by Mixter.¹³⁶ Premature labor followed the attack, and an abdominal tumor demanded operation. The appendix was found at the lower end of the kidney, its position having possibly been altered by the pregnant uterus. Fecal concretions were present. The patient recovered after operation.

Albuminuria and **peptonuria** are variations in the metabolism of the pregnant patient, and are of interest and importance to the obstetrician. The clinical importance of the presence of serum-albumin in the urine in pregnancy has been greatly exaggerated, and a closer study of the excretions has demonstrated its very limited significance. In accordance with the preciseness and the delicacy of the tests employed serum-albumin has been found to be present by Schroeder in from 3 to 5 per cent.; Ingerslev, 4.8 per cent.; Fleischlen, 2.6 per cent.; Meyer, 5.4 per cent.; while Lantos, in an interesting series of observations at Budapest,¹³⁷ found albumin in 18 per cent. of pregnant women and in 60 per cent. of those recently delivered. In thirty-nine fatal cases, in which the urine had contained albumin, the patients had suffered neither from eclampsia nor from nephritis. The kidneys in these cases were very pale and anemic. Lantos is convinced that albuminuria is very common among pregnant women, that it results from reflex irritation of the vaso-motor nerves of the renal vessels, and that it has no pathological significance; it may, however, be of value as a sign of pregnancy in making a differential diagnosis. Peptone has been found in the urine of pregnant women, and it is thought by some to be an evidence of the death of the fetus. Thomson¹³⁸ could not observe that peptone was characteristic of the pregnant condition, nor that it is a symptom of a macerated or a dead fetus. According to his researches, peptone appears intermittently without appreciable cause in the urine during pregnancy and after labor. From the researches of Koettwitz,¹³⁹ who examined the urine in 31 cases of pregnancy, we may believe that peptone is not a sign of fetal death. Its presence seems a physiological phenomenon, only becoming pathological when this substance is found in excess. In complicated labor where maceration of the fetus and severe visceral disease of the mother are present it has been found.

The treatment of albuminuria and peptonuria during pregnancy consists in interference and rational hygiene. As most pregnant patients eliminate insufficiently, such forms of diet as agree best with the individual case should be enjoined. The peculiarities of the individual should be studied closely, and the whole range of therapeutic and medical art will frequently be taxed to aid the patient in solving the difficult problem of nourishing herself and her unborn child. Many specific treatments have been urged for albuminuria; among them is the benzoic-acid treatment, sometimes combined with bicarbonate of potassium. Various purgatives have been given in these cases, the best purgatives being those that do not introduce into the blood of the patient a

large amount of potassium salts. In general it may be said that the presence of albumin or of peptone in the urine of a pregnant patient is not of itself a pathological phenomenon, and it is only when the presence of albumin is associated with casts and deficient excretion, as indicated by deficient urea, that albumin becomes an indication of disease.

Abnormal conditions of the mouth and teeth during pregnancy may occasion considerable distress and inconvenience to the patient. The gums frequently become abnormally soft, and a condition known as "white caries" is often seen in the teeth. The edges of the gums are thin, pale, somewhat shrivelled in appearance, and retracted from about the teeth. A prominent ridge along the free border, often of deeper tint than the surrounding membrane, is sometimes observed. In other cases the gums are reddish and are apparently softened, exuding a thin fluid or pus from around the neck of the tooth. Such a condition does not imply neglect of cleanliness, but it seems a passive congestion and transudation from the tissues. It has been shown by Elliott¹⁴⁰ and others that this condition of caries in the teeth results from the altered secretions in the oral and buccal cavities. The secretion of saliva is much increased, ptyalin being often absent. The saliva early in the day is often of acid reaction, and this is thought to have a potent influence upon the development of caries of the teeth. This disorder is sometimes known as "brown caries" when extensive discoloration of the teeth is present. The margins of cavities in these cases are black. A line of brownish discoloration sometimes occurs upon the upper incisors or the canines. The enamel is opaque. This form of caries generally begins in the region of the bicusps of the upper or lower jaw, and is usually found among patients of the lower classes. Softening of the dentine of the upper bicusps and molars is sometimes observed, apparently because the bicusps are those teeth against which fluid is most forcibly ejected in the emesis of pregnancy; they are also in contact with the tongue at rest. General softening of the teeth without actual decay, and loosening of the teeth in their sockets from partial absorption of the alveolus, are also observed. White or soft caries is often found in an inexplicable manner in patients apparently well nourished, and in its pathology resembles osteomalacia.

Affections of the nerves of the face and the teeth often accompany the structural conditions mentioned. By some, altered nervous conditions in these parts are referred to pathological conditions in the mucous membrane of the stomach. Occasionally pain in the mouth and teeth is purely reflex from the uterus, as in a case described by Garrettson in which pain was felt about a carious tooth. Its removal brought no relief, but the healing of an ulcerated cervix uteri caused the pain to disappear.

The treatment of these conditions is to be found in a proper attention to the general condition of the patient. Locally, chlorate of potassium and bromid of potassium are useful when the gums are irritable. Powdered boracic acid may be brushed upon the teeth with a soft brush, or equal parts of charcoal and precipitated chalk may be used for short periods. In reflex

pain, felt in sound teeth, a blister over the fourth or fifth dorsal vertebra has been of use. Absolute alcohol and collodion may be painted over a tooth attacked by soft caries. When carious cavities require filling, this should be accomplished with as little distress to the patient as possible, and the filling should be of a non-irritating character. When a tooth occasions severe suffering during pregnancy there are many reasons for advising its removal, as pregnancy has been interrupted as the result of such distress, while the presence of continued pain has an undoubted influence upon the development of the child.

Exophthalmic goitre and **simple goitre** may develop rapidly during pregnancy, and by the associated changes which occur in the circulation may result disastrously to the fetus. Thus in a case reported by Haberland¹⁴¹ the rapid development of exophthalmic goitre was accompanied by premature separation of the placenta, with death to the fetus at eight months. The termination of labor was followed by immediate cessation of the development of the goitre. In severe cases such patients become excessively nervous, the hands tremble violently, palpitation of the heart and a sense of constriction about the throat are present, with considerable emaciation. Vomiting is also a symptom in well-marked cases. While palliative treatment may temporarily relieve these patients, if the symptoms be urgent a removal of the goitre should promptly be undertaken.

Abnormal conditions of the blood are not of very infrequent occurrence. The normal condition of the blood during pregnancy in ill-nourished women is that of temporary anemia, which soon gives place to a development of physiological plethora and hyperemia. It has been shown by Dudner¹⁴² and others that so soon as the balance of nutrition becomes established a steady increase in the amount of corpuscles and hemoglobin is to be observed. Narse¹⁴³ found the specific gravity of the blood during pregnancy to be 1025. The amount of fibrin increases, while the quantity of salts and hemoglobin diminishes. Winckelmann¹⁴⁴ found that as pregnancy advances the quantity of hemoglobin increases. Schroeder¹⁴⁵ considers anemia in pregnancy as the exception and as a pathological condition, while neither he nor Meyer¹⁴⁶ observed a great decrease in hemoglobin or corpuscles. The observations of Ingersleff,¹⁴⁷ Wehling,¹⁴⁸ and Meyer¹⁴⁹ upon the comparative composition of the blood in the pregnant and the non-pregnant show that in the former the number of red corpuscles is slightly decreased and also the amount of hemoglobin during early pregnancy.

Anemia in the pregnant is produced by the same causes which influence the non-pregnant. Its recognition is effected by the same methods of examination and diagnosis employed in the study of internal medicine. The condition of anemia complicating pregnancy was early recognized by American physicians, whose contributions to the literature of the subject are among the first. Cazeaux and the French school ascribe to anemia many of the disorders of pregnancy. A curious aversion to the treatment of anemia during pregnancy by methods usually employed in non-pregnancy is shown in the records of

a malpractice suit reported in 1871 by Woodman to the Obstetrical Society of London, when a physician was sued for using the ammonio-citrate of iron in the treatment of this condition. It was claimed that he had thus produced abortion. The verdict of the society was in favor of the physician. Gussierow¹⁵⁰ reports five cases of extreme anemia in the pregnant state. The eighth month seemed the period most favorable for the development of this complication. Bischoff and Biermer report cases of oligemia and anemia with cachexia at about this period.¹⁵¹ Cameron's excellent description of leukemia during pregnancy¹⁵² includes a case with a marked family history of leukemia. Sanger¹⁵³ reports the case of a leukemic mother who bore a healthy child, and also of a healthy mother who gave birth to a leukemic child. Davis¹⁵⁴ reports the case of a multigravida seized with hematogenic jaundice. Examination of the patient's blood showed the condition of pernicious anemia. The blood of her fetus was found to be normal. Under treatment her condition greatly improved after delivery.

While it is possible for these patients to bear healthy children, still pregnant women suffering from various forms of anemia and leukemia are subject to dangerous symptoms as pregnancy advances and as the pathological condition of the blood becomes pronounced. Important symptoms are epistaxis, hematemesis, and melanemia, with the development of a purpuric condition. Attention has been drawn by Laubenberg¹⁵⁵ to the severity of this complication and to its almost inevitable interruption of pregnancy, and he urges the early induction of labor as the duty of the physician.

The most serious condition of the blood attacking the pregnant patient is *purpura hemorrhagica*. Its occurrence and severity in pregnant women are explained by the sympathy existing between the utero-ovarian and the tegumentary systems of the body. This nervous connection is often observed in the skin eruptions which accompany disorders of menstruation. As has been shown by Immermann, the complication is sporadic in pregnant patients, and it occurs without regard to family history or to previous condition. Phillips¹⁵⁶ collected cases illustrating the absence of previous history of hemophilia in these patients. In some of them hard work and insufficient nourishment seem to have produced the disorder. Profound mental disturbance has occasionally been followed by this condition. In Phillips' case the child showed no symptoms of purpura, and the mother recovered rapidly after labor. Kaezmarsky¹⁵⁷ reports a case in which severe sacral pain during pregnancy was the first symptom. The birth of a dead fetus followed speedily, and the mother perished from hemorrhage. Dohrn reports twin pregnancy with this complication, with severe postpartum hemorrhage and death. Both these patients had previously been healthy. Wernicke, Recklinghausen, Hanot, and Luzet offer evidence which seems to prove, on the one hand, that the disorder is a form of infection by bacilli; on the other hand, the cases described by Dohrn¹⁵⁸ do not point to this condition as causative. The immunity of the fetus in these cases is inexplicable and of interest. Microscopic study made of the blood in this complication by Gibbon during the height of an attack of purpura showed that the red cor-

puscles contained numbers of black granules massed together in some of the cells. These bodies increased as the disorder became severe, and diminished in convalescence. The number of corpuscles early in the disease was over 5,000,000 per cubic millimeter, this number being greatly diminished as the disorder made progress. The white corpuscles became excessive, and the hemoglobin fell to 30 per cent., afterward rising to 60 per cent.

The treatment of anemia and leukemia complicating pregnancy consists in securing thorough elimination, and in the employment of those forms of treatment found useful in the non-pregnant patient. Osler¹⁵⁹ obtained good results from the persistent use of arsenic, the free use of iron, the inhalation of oxygen, systematic and forced feeding, and, of great importance, the correction of the condition of gastro-intestinal catarrh so often found in these cases. The patient's strength should be conserved in every possible manner. Should purpuric eruption develop, with hemorrhages, antiseptic dressings must be applied over these areas, and care should be taken that bichlorid of mercury is not employed, the susceptibility of anemic pregnant patients to mercurial poisoning being a contra-indication to its use. Bichlorid of mercury in minute doses should be given when a possible syphilitic taint is suspected as a complication. The prompt induction of labor is required in cases where the disorder steadily increases in severity, although this procedure when the patient has reached a critical condition is useless and unjustifiable. If done at all, labor should be induced promptly and while there yet remains sufficient strength to justify a hope that the patient will rally.

Cardiac disease complicating pregnancy is not infrequently observed. In those patients who are well nourished slight cardiac lesions are frequently undetected during pregnancy and cause no embarrassment at labor. A physiological hypertrophy of the heart occurring during pregnancy is well described by Larcher, who found hypertrophy of the left ventricle in pregnant women. Other observers assert that this hypertrophy is associated with dilatation of the right heart. Istria¹⁶⁰ and others maintain that pregnancy often induces endocarditis, and other observers have noted the development of endocarditis after repeated parturition. The most fatal of these lesions in the pregnant patient is mitral stenosis. Marshall¹⁶¹ and Duckworth demonstrated the remarkable preponderance of this form of heart disease in women. Direct cardiac symptoms are comparatively few, consisting of palpitation, sometimes pain and depression. Bronchial catarrh is generally observed. The want of concurrence between the cardiac systole and the impulse given by the pulse-wave is an interesting and important diagnostic point in these cases. Cases reported by Fritsch, Budin, Macdonald, and Malherbe illustrate the occurrence and fatal termination of this disorder. The results of this lesion in 14 cases given by Macdonald were death in nine. Porak saw eight fatal cases out of 13. Remy in 19 cases found eleven fatal. In double mitral lesion seven out of Hart's 8 cases perished. In one-half of the cases recorded pregnancy has been interrupted without interference. Half of these patients died and half of them

recovered. The predominance of pulmonary symptoms in mitral stenosis should be borne in mind in making a diagnosis and in instituting treatment.

While the mortality of pregnancy complicated by mitral stenosis is more than 50 per cent., aortic lesions give a mortality of 23 per cent. Mitral insufficiency is accredited with 13 per cent., while in complex lesions of the heart a mortality of 50 per cent. is a conservative estimate. The prognosis for the continuance of pregnancy and for the life of the child is distinctly unfavorable. Mackness¹⁶² reports a case of pregnancy complicated by aortic and mitral disease in which labor was induced. Partial recovery ensued. The patient's condition of prostration became so excessive during the latter portion of her pregnancy as to require vigorous stimulation. She was greatly prostrated by persistent emesis and paroxysms of oppression, which were relieved by the administration of nitrite of amyl.

Merklen¹⁶³ reports an illustrative case in which pulmonary tuberculosis was associated with stenosis at the mitral orifice. Dilatation of both sides of the heart was present, with general anasarca and exaggerated pulmonary congestion. Venous stasis in the kidneys was well pronounced. Pulmonary hemorrhage occurred, and it was a temporary relief to the patient.

Hemoptysis complicating pregnancy may occur from simple pulmonary congestion in cases of valvular heart disease, or may result from disease of the parenchyma of the lung, most commonly tubercular. Martin¹⁶⁴ describes the case of a patient four months pregnant who suffered from obstinate and persistent hemoptysis. There were pulmonary signs of consolidation anteriorly below the right clavicle. Bleeding occurred at about the time when the patient would have menstruated had she not been pregnant. Epistaxis subsequently developed, and later a profuse red rash, resembling that of scarlatina, covered the body. This rash gradually faded, and was not attended by fever or any signs of other complication. Pulmonary signs gradually improved, especially under treatment by a succession of blisters upon the chest, that gave marked relief. The patient entirely recovered and went to the usual termination of pregnancy.

Hemorrhage from the Uterus.—The fact that profuse hemorrhage from the uterus may occur during pregnancy and still the patient go on to the end of gestation is well illustrated in a case described by Robertson.¹⁶⁵ His patient was a multigravida who had several hemorrhages so severe as on each occasion to cause the supposition that abortion had occurred. Her pregnancy continued to a successful termination.

Internal hemorrhage is observed as a complication in patients suffering from nephritis during pregnancy. To such an extent may symptoms of shock and acute anemia be present that placenta prævia has been suspected in these cases. Schauta¹⁶⁶ reports the case of a woman, aged forty-four, who had borne nine children, and in whom profuse hemorrhage caused a diagnosis of placenta prævia. Although the patient was not in labor, the os was sufficiently dilated to permit a diagnosis to be made that placenta prævia was not present. Transfusion by normal salt-solution was immediately performed, and when the patient rallied,

as the child was dead, it was extracted by craniotomy. A large amount of clotted blood was found in the uterus and vagina. The patient succumbed from the hemorrhage shortly after delivery. The post-mortem examination revealed chronic nephritis as the only complication accounting for the condition. Winter observed three similar cases in Schroeder's clinic.

3. ACUTE INFECTIONS DURING PREGNANCY.

The condition of pregnancy renders the patient peculiarly liable to the rapid development of infective germs. The body of the pregnant woman presents that condition of plethora and hyperemia in the viscera that invites the growth of bacteria. It is not, then, difficult to understand why these complications of pregnancy are among the most severe. First among these disorders may be considered those in which the infection usually gains access to the body through the genital tract. Such disorders are gonorrhea, syphilis, and cancer.

Gonorrhea is by no means an uncommon complication of pregnancy, and in an ignorant woman no intelligent history attracting the attention of the physician to the condition present may be afforded. The complaint, however, of difficulty in micturition and of burning and irritant discharge should occasion an examination, when specific vaginitis may be detected. The symptoms and treatment of this disorder in the pregnant are essentially those in the non-pregnant, but the pathology of the condition is more complex and of greater import. Not only may the gonococci infect the mucous membrane of the vagina, and possibly cause abscess of Bartholini's glands, with occasional acute inflammation of the rectum and the surrounding tissues, but the endometrium also may be attacked, and even the fetus may be infected *in utero*, by the gonorrheal virus. Children have been born with gonorrheal ophthalmia and under circumstances which precluded the possibility of infection during birth. Such infection, however, is of comparatively little importance when compared with the dangers arising to the mother from the development and retention of gonorrheal infection in the tissues about the uterus and in the tubes and ovaries. The entire genito-urinary tract of the mother is liable to such infection, the consequences of which may not become apparent until some time after delivery. Thus, in the writer's observation a patient perished from the sudden and acute septic infection occasioned by the spontaneous rupture of a small gonorrheal ovarian abscess occurring two weeks after delivery. This patient's puerperal period had apparently been normal, and the infection must have been received before or during pregnancy. The same observer witnessed death from nephritis in which the genito-urinary tract had been the seat during pregnancy of gonorrheal infection. In this case the tubes and ovaries escaped, but the bladder and kidneys showed abundant infective germs. The presence of gonorrhea as a complication of pregnancy should lead to prompt antisepsis of so much of the genital tract as is accessible. If the bladder is invaded, it should also be subjected to the same thorough antisepsis. At the time of labor all possible precautions

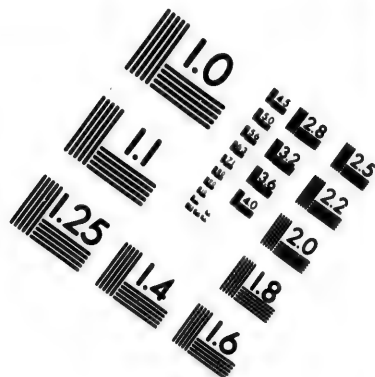
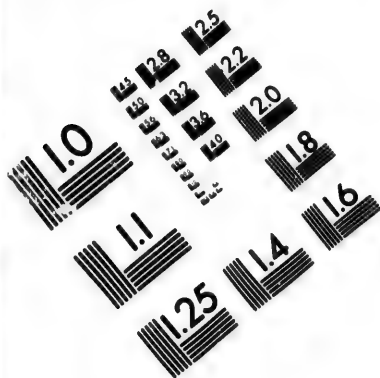
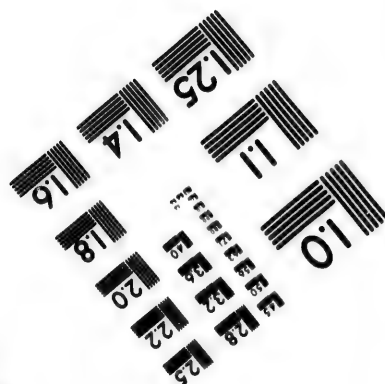
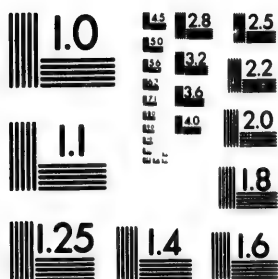


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should be taken to avoid violence to the uterus or its appendages that may set free retained gonorrheal poison. During the puerperal period the occurrence of septic inflammation in and about the uterus should be treated promptly by intra-uterine antiseptics, or so soon as possible by abdominal incision. It is folly to treat the insidious ravages of gonorrhea in the connective tissue, the peritoneum, and contents of the pelvis occurring after labor by any but prompt surgical measures. Exploratory abdominal incision is far more conservative in these cases than delay.

Syphilitic infection during pregnancy in many cases runs the usual course of this disorder, and in others it assumes peculiar malignancy. Pathologically speaking, the virulence of syphilitic infection in pregnancy depends not only upon the patient's powers of resistance, but also upon septic germs which may be associated with the bacillus of syphilis. Some of the most malignant types of puerperal sepsis are observed in patients who become syphilitic at conception or during pregnancy. In these patients the syphilitic eruption is so masked and exaggerated by the septic element present as to occasion great difficulty in diagnosis. The writer recalls a case of this sort where close study by Kaposi was necessary to differentiate between an acute syphilitic exanthem and septic infection. Hirigoyen¹⁶⁷ describes the occurrence of syphilis in 34 patients, who comprised 5 per cent. of the total number of pregnancies under observation. Other statistics seem to indicate that this percentage is the usual one in pregnancy occurring in large cities.

The influence which pregnancy exerts upon women already syphilitic has been described by Fournier, who laid down the maxim that a syphilitic woman who becomes pregnant is much more likely to abort than is a pregnant woman who becomes syphilitic. The percentage also of fetal death in syphilitic women who become pregnant is much greater than among pregnant women who become syphilitic. The age of the syphilis exercises a very distinct influence upon the prognosis of the pregnancy: the longer the woman has been syphilitic before pregnancy occurs, provided she has not been subjected to efficient treatment, the worse is the prognosis for the continuance of the pregnancy and the life of the fetus. The prognosis of pregnancy is also very serious the earlier in the pregnancy the infection occurs; thus, the majority of pregnancies complicated by syphilitic infection occurring during the first four months result in the death of the fetus. When infection occurs from the fourth to the sixth month of pregnancy 50 per cent. of children are lost. During the last three months of pregnancy the complication of syphilis results in the death of less than half of the children. General fetal mortality in syphilis is under the best circumstances 75 per cent.

The mother's health in pregnancy complicated by syphilis is liable to rapid deterioration if the syphilitic process be acute. The stimulus of pregnancy seems to exaggerate the spread of the poison and the various lesions which it causes. To be efficient, antisyphilitic treatment should begin as soon as the infection occurs, and the earlier in the pregnancy such treatment is

begun the better are the results obtained. Local treatment of syphilitic lesions complicating pregnancy consists in thorough cleanliness and in the maintenance so far as possible of local antisepsis. Ulcers should be dusted with calomel and iodoform; the parts should be kept thoroughly clean with antiseptic douches, and the discharges from syphilitic patients should be received upon absorbent material, which is then burned. Antisyphilitic medication is to be conducted in accordance with the therapeutics of this disorder in the non-pregnant. The biniodid of mercury, the bichlorid of mercury, calomel, gray powder, and the bichlorid hypodermatically are all of use. Inunctions with mercurial ointment are found advantageous in many cases. In those patients with whom mercury does not agree iodid of potassium in combination with iodine may be used to advantage. The following mixture has proved efficacious in a number of cases:

Iodin,	gr. iv ;
Iodid of potassium,	3iv ;
Compound syrup sarsaparilla,	3iv.
Dose, one teaspoonful after meals.	

Besnier¹⁶⁸ obtained good results with a pill containing $\frac{1}{8}$ of a grain of bichlorid of mercury with $\frac{1}{12}$ of a grain of extract of opium and $\frac{1}{12}$ of a grain of extract of gentian, rubbed up with glycerin.

Equally important with the specific treatment of syphilis in pregnancy is the tonic treatment which these cases demand. Well-ordered feeding, in which an abundance of fat in cod-liver oil or other forms is included, and the persistent administration of iron, arsenic, nux vomica, and such substances as stimulate digestion, are of the greatest importance. The aim of the physician must be not simply to tear down diseased tissue, but to build up that which is sound. The results of such treatment are often most gratifying. The characteristic lesions of syphilis fade with great rapidity in these cases; the patient who may have repeatedly aborted goes on nearly or quite to term, and a fairly-developed and healthy child is born. Neglect, however, or inadequate treatment for these patients often results in sad ravages in the mother's tissues, resulting very frequently in fetal death.

Cancer complicating pregnancy affects the course of gestation chiefly in its local manifestations in the genital tract. In rare instances multiple sarcomata develop with great rapidity in various portions of the body, causing death by constitutional infection. In other instances cancer of the uterus by metastasis speedily reduces the patient to a condition of threatened collapse, often resulting in constitutional septic infection. In such cases the interruption of pregnancy seems of very little avail for the patient, except in so far that the malignancy of the cancerous process seems less acute if the uterus is emptied.

Typhoid infection during pregnancy seriously complicates the mother's chance of convalescence from labor, and frequently results in the death of

the fetus. In a case described by Findlay¹⁶⁹ the husband had been ill for some time with typhoid infection. The patient's pregnancy was terminated at about the expected time, labor occurring with a temperature of 103° F. and the pulse 140. The uterus contracted well, although during labor intestinal peristalsis was active and the patient had diarrhea, which subsided after delivery. The secretion of milk did not occur, the breasts remaining without signs of activity. The skin of the child was shrivelled, and after a few days it showed an eruption with bullous spots, the scars of which persisted when the child had reached adult life. Pregnancy is interrupted in these cases by continued high temperature, by hemorrhage in the endometrium or in the membranes of the ovum itself, and by a depressed condition of the maternal circulation, with asphyxiation of the child. Kaminski, Zulzer, and Scanzoni observed in two-thirds of their cases the interruption of pregnancy. The fact that the fetus may become infected by the transmission of the germs of typhoid through the placenta has been demonstrated by Giglio.¹⁷⁰ The latter examined carefully a fetus and its appendages born from a mother suffering with typhoid fever in an epidemic at Palermo. Pregnancy terminated forty-six days after the beginning of the fever. Although the specimen seemed normal on casual examination, cultures of the maternal blood demonstrated the presence of the typhoid germ, while cultures from the milk revealed bacteria exactly resembling those obtained from a typhoid non-pregnant patient. The fetus and its appendages also contained typhoid bacilli. Boyd¹⁷¹ reports a case in which a week after the fever began premature labor occurred. The patient finally succumbed after continued high temperature.

The *diagnosis* of typhoid fever complicating pregnancy presents no especial difficulty. Should the physician see the case during the puerperal period, it must not be mistaken for puerperal sepsis, nor should puerperal sepsis complicated by diarrhea be mistaken for typhoid fever. It will be remembered that in septic cases diarrhea is a not infrequent symptom. The *treatment* of typhoid fever during pregnancy should be addressed to controlling the temperature and to maintaining the patient's strength. Such cases are especially fitted for the treatment of pyrexia by the bath and pack. The latter is most efficacious where the very energetic application of cold has a tendency to prostrate the patient. No fear need be felt regarding the induction of labor by treatment addressed to controlling the temperature, for it will not be such treatment, but its failure to modify the fever, which will bring about a premature ending of gestation. The fact that in many pregnant patients suffering from typhoid the stomach is excessively irritable will lead the physician to abstain from the administration of drugs by the stomach so far as possible.

Erysipelas during pregnancy is of not infrequent occurrence, and it is grave or is slight as a complication in accordance with the accompaniment of other forms of septic germs. Facial erysipelas may occur in the pregnant patient, and even abortion may follow, without the development of puerperal sepsis. Such a result, however, is possible only when strict antiseptic pre-

cautions are observed. Erysipelas of the genital tract—or of the lower extremities, where the infective germ gains ready access to the genital tract—results almost invariably in puerperal septic infection. The symptoms of erysipelas complicating pregnancy do not differ essentially from those of the disorder in the non-pregnant patient. The *treatment* consists in supporting carefully the patient's strength, and in avoiding all unnecessary examinations and manipulations in the genital tract, as interference with this portion of the patient's body is an added risk of infection. Smith¹⁷² reports the case of a woman six months pregnant who injured her knee. Erysipelas developed in the thigh eight days afterward, and it was followed by a large abscess burrowing beneath the muscles. Premature labor occurred at seven and a half months. The puerperal period was normal and the child survived. In a recent case of facial erysipelas under the observation of the writer the mother suffered but slight inconvenience from the infection, but gestation terminated prematurely, the child surviving.

Erysipelas of the face and head seems to affect the fetus in many cases quite as markedly as in erysipelas of the pelvic organs. Cohn¹⁷³ reports a case of facial erysipelas at eight months' pregnancy. The fetus, prematurely born, showed upon the corresponding portions of the head and face an edematous red swelling which gradually faded, followed by desquamation. Examination of the infiltrated tissues for erysipelas-germs gave negative results. The child perished from multiple abscesses in the kidneys. A similar condition of the fetus has been described by Runge, Kaltenbach, and Stratz.

Measles.—Of about the same relative virulence as erysipelas is the infection of measles attacking the pregnant patient. The symptomatology of this disorder occurring during gestation does not differ essentially from that ordinarily observed. If the bronchitis usually accompanying measles be severe, the incessant cough and movements of the abdominal walls thus occurring greatly increase the probability of abortion. The child may be born with an anomalous eruption or it may apparently escape. The prognosis of measles complicating pregnancy is to be based upon the severity of the infection, and especially the continuance of high temperature.

The infection of measles may be transferred from mother to child, as illustrated by a case described by Lomer;¹⁷⁴ the child perished from intestinal catarrh; the mother recovered. The child's eruption was characteristic on the forehead and breast a few hours after birth. Gautier¹⁷⁵ found measles transmitted from mother to fetus in six out of 11 cases; the maternal mortality of the 11 cases was two.

Scarlatina is a serious complication of pregnancy, and its virulence is shown from the great promptitude with which it affects the fetus *in utero*. The fact that the germ of scarlatina is morphologically held by many observers to be identical with various forms of septic bacteria renders scarlatinal infection of grave import. An illustrative case is reported by Ballantyne and Milligan,¹⁷⁶ in which the infection occurred during the seventh month of

pregnancy. Two days later gestation ended, and the fetus was found to have scarlatina.

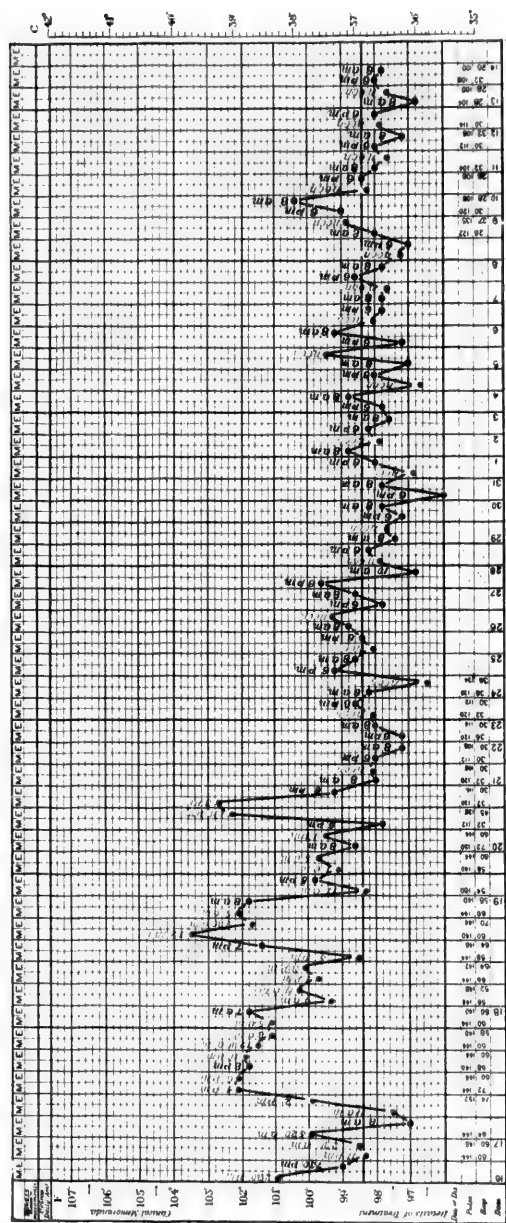
In 21 cases of scarlatina during pregnancy Meyer¹⁷⁷ found it impossible to detect the medium of contagion. The incubation period was from three to five days. In six out of 21 cases the disease ran a mild course without complications. In 8 cases sepsis occurred with two deaths. The resemblance of puerperal scarlatina to diphtheritic infection of wounds was strikingly illustrated in Meyer's complicated cases. The interruption of pregnancy by scarlatina is well illustrated by Remy;¹⁷⁸ abortion occurred at five months, the patient making an uncomplicated recovery.

Variola resembles scarlatina in its infective energy and in its rapid transmission to the fetus. It possesses, however, the fortunate distinction of being susceptible to modification by vaccination. While pregnancy renders the mother more liable to the infection of small-pox, in those cases in which variola occurs in women who have formerly been vaccinated the disease runs a comparatively mild and favorable course. Vaccination during pregnancy is to be performed without hesitation whenever variola is epidemic. Especial care should be exercised in procuring pure virus, and antiseptic precautions are necessary in performing the vaccination. There is abundant reason to believe that the fetus is protected by such vaccination.

Pneumonia during pregnancy is a serious complication for mother and child. The interference with respiration occasioned by the size of the pregnant womb, and the unfavorable conditions under which the heart labors during pregnancy, account in large part for the severity of the complication. Jurgensen, among 2475 women suffering from pneumonia, found 43 who were pregnant. Of this number more than half aborted. As in the other infections, the degree of fever present is of great importance in prognosis. The symptomatology of pneumonia in the pregnant does not differ from that of the disorder in the non-pregnant. It is observed, however, in pregnant patients that embarrassment of the circulation is very often present, and that heart failure develops more rapidly than in the non-pregnant. Mann¹⁷⁹ reports the case of a woman aged forty-two with typical pneumonia at eight months' pregnancy. The fetal heart-sounds ceased five days after the initial chill. Shortly after the crisis of the pneumonia the child was born with the aid of forceps. During labor the patient became cyanotic, and she was allowed to bleed freely from the umbilical cord: although an unfavorable prognosis had been given, the patient made an uninterrupted recovery. The writer reports in this connection the case of a young primigravida aged twenty who developed pneumonia when near the end of gestation. A temperature of 103° F. rapidly developed, and an acute pneumonic process catarrhal in nature was found over both lungs. Although the os was partly dilated, no labor-pains were present. The patient's distress and dyspnea steadily increased, and three days after the beginning of the pneumonia the child was expelled with three or four powerful labor-pains. The child was cyanosed, had fever, and after passing through an attack of pneumonia recovered (Pls. 20, 21).







Fetal pneumonia during pregnancy, with recovery after birth: chart of the infant.

Although the mother's urgent symptoms were relieved temporarily by her labor, she perished of heart failure soon afterward. Examination of her urine during the pneumonia and before her delivery showed the presence of albumin in appreciable quantity, and the proportion of urea was 1.2 per cent. Epithelium from the kidneys, with abundant crystals of oxalates of lime, were found by microscopic examination. The urine contained large quantities of bacteria of various kinds.

The treatment of pneumonia complicating pregnancy is that of the non-pregnant. The patient is in no way improved by the induction of labor, and the occurrence of labor should often be made the occasion for depleting the circulation through controllable post-partum hemorrhage. Pneumonia complicating pregnancy offers more opportunities for depletion than does pneumonia in the non-pregnant woman, and symptoms of threatened asphyxia with profound cyanosis should be met promptly by this resource. Cupping gives great relief in these cases, while the hypodermatic use of strychnia and atropia has proven of comfort to the patient. The complication is serious in proportion to the extent of lung-tissue involved and the tolerance or intolerance displayed by the circulatory apparatus.

The prognosis of pneumonia occurring during pregnancy has been made the subject of study by Wallich,¹⁸⁰ who found that pneumonia interrupts pregnancy in one-third of all cases before the sixth month, and from the sixth to the ninth month in two-thirds of all cases. The maternal mortality varied from 50 to 100 per cent. of recorded cases, while the fetal mortality was 80 per cent.

Cholera during Pregnancy.—Cholera during pregnancy well illustrates the severity of a pronounced infection with the pregnant patient. From a series of 10 cases Klautsch¹⁸¹ describes two stages of the disease—one attended by copious evacuations from the stomach and intestines, the second by a period of intoxication or asphyxia. The patients were usually taken ill at midnight or early in the morning, and when temporary relief from the symptoms of collapse had been obtained by the injection of saline fluids a typhoid stage frequently developed, with active delirium, followed by deepest coma. During the coma the pulse was strong, dicrotic, and the respiration irregular. Hemorrhage into the conjunctivæ was often present. The fetus usually perished in these cases during the stage of intoxication. The mothers complained that in the first stage of the disease fetal movements were excessively violent. It has been shown by Slaviansky, Tippiakoff, and Simmonds that the epithelium of the placenta is extensively diseased, and that hemorrhages and premature separation often occur. Where the fetus died it was usually expelled at the end of the stage of asphyxia and in the beginning of the typhoid delirium. Instrumental delivery was frequently necessary. Post-partum hemorrhage was rarely observed, and where the mother survived involution often proceeded promptly. As regards the prognosis for the mother, it was as good as the prognosis in cholera in non-pregnant women. For the fetus the prognosis was excessively grave. The treatment of preg-

nant patients attacked by cholera is the treatment of cholera in the non-pregnant. No attention should be paid to the pregnant condition, other than to complete labor as rapidly as possible when it begins, and to secure good uterine contractions during and after the labor. A more unfavorable view of the prognosis for the mother is given by Galliard.¹⁵⁶ In his cases the lactic-acid method of treatment was extensively employed with negative results. In mild cases a number of his patients recovered.

Tetanus in Pregnancy.—Among the acute infections that attack with great virulence the nervous system of the pregnant patient tetanus is the most formidable. Our knowledge of infection explains by the tetanus bacillus the exciting cause of this complication. A predisposing cause is to be found in the susceptibility which pregnant patients manifest during the first three months of this period. Indeed, the first half of gestation shows by far the greater number of cases of this infection. Tetanus develops usually after some minor manipulation in the early months of pregnancy, and especially where abortion requires interference on the part of the physician. Thus Vinay¹⁵² in 106 cases found but one after craniotomy and one after Cesarean section; the infection is one of early pregnancy, and is not usually connected with parturition at term. Patients most apt to be attacked by the tetanus bacillus are multiparæ above the average age and those who have been living in damp and squalid lodgings. The direct conveyance of the infection has been noted by Henricius and by Amon. The latter, while treating a case of tetanus in the husband, infected the wife, who aborted, during the manual delivery of the placenta. Tetanus is most frequent among pregnant patients in the tropics, where the condition of the soil is favorable to the growth of the infecting germ. An association of tetanus in pregnancy and the puerperal period with endometritis has been pointed out by Markus.¹⁵³

The treatment of tetanus in pregnancy is largely prophylactic. Remembering the peculiar susceptibility of pregnant patients, especially during the first months, any minor operation or examination should be conducted with scrupulous antisepsis. When once tetanus infects has occurred, but little can be done to save the patient.

Tetany is a condition which is commoner during pregnancy than is tetanus. It is characterized by tonic spasms beginning in the muscles of the extremities, especially those of the hands. In severe cases spasmodic movements may extend over the entire muscular system. The spasms are symmetrical when not artificially produced. Attacks of tetany are not accompanied by loss of consciousness. Such seizures are intermittent and of short duration. As a rule, recovery ensues, the spasms gradually becoming less frequent. Patients describe a tingling or a numb sensation of the extremity affected as preceding the spasm, and the same phenomenon follows the cessation of convulsive movements. If the main artery or the nerve of the extremity in which spasmodic movements are observed be compressed, these sensations, followed by spasm, may be induced. The application of cold causes the spasms of tetany to cease. The flexor muscles, and especially the interossei in the hands and feet,

are oftenest affected. The electrical reaction of the nerves in the affected region is much increased. The patient's general temperature is not affected. Any mechanical irritation of the peripheral nerves, such as tapping the trunk of the facial nerve in front of the ear, results in spasm. The disorder is generally sporadic and is rarely epidemic. It is most usually observed in women during the childbearing period or during menstruation. Trousseau found, of 44 cases, forty amid nursing women. Kussmaul found transient albuminuria present, and Stiel observed glycosuria. Dakin¹⁸⁴ reports the case of a multigravida of nervous temperament who in the third month of her fourth gestation was seized with frequent vomiting during the day. After this condition had persisted for eleven days she developed spasm of various muscles, preceded by numbness. The hands and feet assumed the posture seen in tetany, the flexors in contraction, and the interossei producing extension of the phalanges. The soles of the feet were hollowed by spasmodic extension. The affected muscles were slightly painful. The condition extended to all the extremities, and vomiting was increased. On the second day of tetany the spasmodic condition became so excessive as to cause intense suffering. The temperature was subnormal. The patient died of asphyxia produced by spasm of the muscles of respiration on the third day of the tetany. Trousseau recognizes three varieties of tetany in accordance with the severity of the affection. He rarely observed a fatal result. Meinert saw five cases end in recovery. In one of these cases the patient suffered from tetany in successive pregnancies. One of Meinert's patients had her thyroid gland removed. Between the attacks of tetany the patient is normal to all appearances. In non-fatal cases the pregnancy is not interrupted nor is labor influenced, the spasms ceasing as soon as the uterus is emptied or within a few days.

In contrasting tetanus with tetany in pregnant patients it is well to remember that in tetanus the spasm begins in the face or the neck, and advances centrifugally with opisthotonos. In tetany the spasm begins in the extremity and advances centripetally, producing the characteristic posture of the extremities. In tetanus the spasm is constant: in tetany it is intermittent. The great fatality of tetanus and the comparative mildness of tetany are to be kept in mind. Tetanus is commonest among men, who by virtue of their occupations are exposed to infection from the tetanus bacillus. Tetany is peculiarly common among pregnant women or women in a depressed and susceptible condition. The differential diagnosis between the convulsions of toxemia and those of tetany is not difficult with accurate observation.

The treatment of tetany in pregnancy consists in giving the patient such sedatives and anodynes as shall procure sleep. Vomiting or diarrhea requires especial attention, as it induces a condition of debility favoring a fatal issue. Abortion should not be produced in tetany, as the disorder rarely fails to yield before intelligent medication.

4. ACCIDENTS AND SURGICAL OPERATIONS DURING PREGNANCY.

Although the nervous system of the pregnant woman is remarkably susceptible in many ways to reflexes, she sometimes exhibits a very decided power of tolerance to severe injury or to surgical interference. The difference in this resisting power, as shown by some patients and as seen to be lacking in others, depends not only upon the condition of the nervous system in these cases, but also upon the normal or abnormal state of the uterus and its lining membrane. In a woman in perfect health a considerable injury or a surgical shock may be received without the interruption of pregnancy, while if the patient is of extraordinarily susceptible nervous system or if the endometrium is in a condition of disease, interruption of pregnancy is almost inevitable. Accompanying the premature ending of gestation serious hemorrhage, shock, and greatly increased susceptibility to septic infection are observed.

Those operations most frequently demanded during pregnancy are surgical procedures undertaken for some condition of the uterus or of its appendages. Thus cancer of the uterus demands the complete extirpation of that organ as soon as the diagnosis is made, irrespective of the existence or the period of gestation. One of two methods of operation may be chosen—extirpation *per vaginam* when the diseased uterus is small, or the complete removal of that organ through the abdominal cavity when its size precludes the possibility of its removal through the vagina. In either instance the prognosis for the recovery of the mother is by no means desperate if the operation be performed before her strength has been reduced by the development of cancerous cachexia. It is sometimes possible to combine the two methods of operation, as in an interesting case reported by Stocker,¹⁸⁵ in which a multigravida was found to have cancer of the cervix. At the sixth month of pregnancy the cervix was removed *per vaginam*, and the complete extirpation of the uterus was accomplished by opening the abdominal cavity. The patient made a good recovery from the operation.

Myomotomy and *myomectomy* are demanded during pregnancy for fibroid tumors complicating the development of the pregnant uterus. The choice of operation will depend upon the size and location of the tumor, and upon the amount of pressure which it is exercising or which it will cause upon the growing womb. Flaischlen¹⁸⁶ found two fibroid tumors behind the uterus in the case of a patient pregnant three months; one tumor sprang from the cornu of the uterus, the other from the base of the womb. Both tumors were ligated and removed without the interruption of pregnancy.

Amputation of the pregnant womb is a familiar operation for contracted pelvis. It may, however, be performed at any period of gestation when the interests of the patient demand hysterectomy. The method of procedure best adapted to such cases is abdominal incision, ligation of the ovarian and uterine arteries, and amputation of the uterus, leaving a short stump to close the vagina and stitching the peritoneum over the surface of the stump.

Tumors of the ovary are justly considered serious complications of preg-

nancy. Dsirne¹⁸⁷ collected 135 cases in which pregnancy was complicated by tumor of the ovary. He finds that the gravity of this complication increases as pregnancy advances. There is rarely any reason in this complication for delay in removing such a tumor by abdominal incision. Puncture of an ovarian cyst and the artificial interruption of pregnancy are to be avoided: they are to be considered only in the light of procedures adapted to an unforeseen emergency. The preferable time for operation in such cases is before the fourth month of gestation. The fetus is least likely to be lost when operation is performed in the third or the fourth month. No period of pregnancy, however, contra-indicates ovariectomy, but this complication uniformly demands operative treatment. Double ovariectomy during pregnancy may be successfully performed, as exemplified by Polaillon.¹⁸⁸ His patient, aged twenty-three, had a good-sized ovarian cyst upon one side and a diseased ovary upon the other side. Her general condition at the time of operation was not promising, and numerous adhesions complicated the removal of the tumor. Operation was performed in the third month of gestation, and it resulted in the continuance of pregnancy, which terminated in normal delivery with a healthy child. The patient's pulse and temperature showed little reaction following operation. Kreutzman¹⁸⁹ reports two cases in which ovarian tumors were successfully removed from pregnant patients without interrupting gestation. One of these women, who was in her second pregnancy, had gone two weeks over time. She had a large ovarian cyst in the left ovary, the pedicle of which had recently become twisted, the contents of the tumor being tinged with blood.

Affections of the Fallopian tubes may call for operative interference during pregnancy. The prognosis in these cases is equally good with that of operation for the removal of ovarian tumors, and the reasons for prompt interference are quite as cogent as in the former case. In hematosalpinx it is often impossible to make a differential diagnosis between this condition and ectopic gestation. This fact is well illustrated in the experience of Doran,¹⁹⁰ who removed both tubes and ovaries from a patient who had suffered from attacks of violent pelvic pain at various intervals. One tube had ruptured, allowing the free escape of blood; the tube contained a structure in the midst of a clot resembling an aborted ovum. It is probable that double ectopic gestation existed. The patient made an uninterrupted recovery.

Accidents and Injuries.—As regards tolerance to general accidents and injuries during pregnancy, American observers have noted the remarkable tolerance displayed by negro women under such circumstances. Thus, Tiffany¹⁹¹ reports the case of a negro woman who fell, striking the abdomen violently against the edge of a tub. Peritonitis with retention of urine followed. The patient, however, under faithful attendance recovered without the interruption of pregnancy. Stab-wounds of the abdomen occurring during the pregnant period, but without interrupting gestation, are reported by Belin,¹⁹² in whose patient a considerable portion of the epiploön protruded from the wound. Sloughing ensued, but the patient made a good recovery.

Richard¹⁹³ describes the case of a pregnant woman who fell, lacerating the abdominal wall near the umbilicus. A mass of intestine protruded as large as a man's head. The woman was at term, and soon after normal labor ensued, from which the patient recovered. Harris¹⁹⁴ describes the case of a woman pregnant six months whose abdomen was torn open by the horn of a bull. Although omentum and intestine protruded, pregnancy was uninterrupted. The viscera were replaced and the wound was closed by suture. A similar case in which a lacerated wound of the abdominal wall 5 inches long was made is reported by Corey.¹⁹⁵ In this case the pregnancy was at the third month. The patient went two hundred and two days longer in gestation, and had a normal labor. Obstruction of the intestine calling for abdominal section is described by Rydygier,¹⁹⁶ who operated in the sixth month of gestation upon a patient who had symptoms of strangulation for seven days. Recovery without abortion ensued.

In fractures retarded union is reported by Petit¹⁹⁷ and others in pregnant women sustaining this accident.

An interesting operation for stone in the bladder upon a patient eight months pregnant is reported by Keelan.¹⁹⁸ The calculus, which weighed 12½ ounces, was successfully removed without the interruption of pregnancy.

Gunshot wounds not penetrating the uterus do not commonly interrupt gestation. A remarkable instance is cited by Prozowsky.¹⁹⁹ The patient was wounded in many places by pieces of lead pipe fired from a gun but a few feet distant. Neither she nor her child suffered, so far as gestation was concerned, from the accident. A pistol-shot wound of the lung occurring during pregnancy, followed by hemorrhage and shock, is reported by Bancroft.²⁰⁰ A healthy child was born at term.

A remarkable case is described by Lihotzky,²⁰¹ which illustrates the fact that the changes occurring in pregnancy may bring into active irritation a foreign body that had previously been inert; he describes the case of a patient perishing from rapid peritonitis in the eighth month of pregnancy. At the autopsy the duodenum was found perforated by a spoon which the patient had swallowed two and a half years previously—an occurrence almost forgotten.

The remarkable tolerance shown by the pregnant woman to direct injury from mechanical causes is illustrated in a case reported by Milner.²⁰² The woman in the sixth month of pregnancy was accidentally shot through the abdominal cavity and the lower part of the thorax, the missile penetrating the central tendon of the diaphragm and lodging in the lung. Localized pneumonia and peritonitis seemed to limit the injury, the wound draining through the lungs by very free expectoration. Recovery ensued, the patient giving birth to a healthy child sixteen weeks later.

Direct mechanical injury may rupture the pregnant uterus, usually causing the death of the patient. It is interesting to observe that the membranes may remain unruptured in these cases, thus obscuring the diagnosis of rupture of the womb. Nengebauer²⁰³ describes a case of suicide in which a primigravida threw herself from the third story of a house upon a stone pavement;

the immediate cause of death was fracture of the skull. The uterus ruptured, and the fetus in its unbroken membranes was found among the mother's intestines. The patient's pelvis also sustained serious injury.

That pregnant women can endure terrible injury complicated by erysipelas, and still go on to term, is illustrated by a case reported in the *Prager medicinische Wochenschrift*, 1881, No. 6. A woman in the eighth month of pregnancy, while working in a brickyard, was buried beneath a mass of earth and rock. A terrible gash was cut through the scalp, and many bruises and lacerated wounds were sustained. Erysipelas attacked the wounds of the scalp, and the patient was for a time very ill. She did not, however, miscarry, but bore a healthy child at term. Fancon²⁰⁴ describes the case of a woman who had an injury to the knee requiring drainage. She was attacked by erysipelas, which spread over the whole body save the genital organs and the head and neck. Her pregnancy was uninterrupted and recovery ensued.

Operations upon the rectum are to be avoided if possible in pregnant patients. It has been shown by Tiffany²⁰⁵ that such operations are an exception to the rule in usually producing abortion or miscarriage. On the contrary, a diseased kidney may be removed from a pregnant patient, as shown by Tiffany,²⁰⁶ with complete success.

While major operations seem well borne by pregnant women, minor surgical procedures of an irritant character are sometimes attended by disastrous results. Thus, Fancon observed in the clinic at Strasburg a case where cauterization over the ankle-joint was practised for a neglected sprain. Abortion followed, complicated by septic infection, necessitating amputation. The patient finally succumbed. Pregnant women often survive burns without the interruption of gestation if the pregnancy is not far advanced and the burn is not severe. Hunt²⁰⁷ reports a case of excessive burn in the ninth month of pregnancy that seems to have affected the fetus directly, for the child was born dead and blistered over an area corresponding with the burns upon its mother's body. Curiously enough, cases are reported where pregnant women have suffered from abscess of the breast, in which the abscess has been opened, curetted, and drained without interrupting pregnancy, although interfering with the breasts usually results in profound disturbance of the uterus. Pregnancy is no contra-indication to excision of the cancerous breast, as illustrated in a case reported by Pilcher.²⁰⁸ Parasitic growths of the abdominal cavity requiring abdominal section have been treated by surgical interference during pregnancy with success. Amputation for crushing injury and severe blows has been sustained by pregnant patients, and recovery ensued. A remarkable case is reported by Fancon, in which a pregnant woman jumped from a second-story window without interrupting the gestation. Amputation at the hip-joint during pregnancy has been successfully performed by Keen.²⁰⁹ The reason for operating was malignant disease of the femur. The patient, who was five months pregnant, had been living in the tropics. She made a good recovery after the operation, without symptoms of abortion during her convalescence.

In deciding upon operations upon pregnant patients care should be taken that the various excretory organs of the body be placed in the best possible condition. All unnecessary shock is carefully to be avoided, as is also hemorrhage. Although a hemorrhage does not seem to produce abortion, it is dangerous, because it renders the patient more susceptible to septic infection. Fractures unite poorly in pregnant patients, and application of cauterizing agents should not be practised during pregnancy. Major operations on the abdominal contents are especially well borne. Pregnancy does not contraindicate operation for diseased conditions of the uterus, the tubes, or the ovaries, provided the fetal sac is not opened.

A striking instance of the benefit which pregnant patients sometimes receive from operative interference is shown by those cases of osteomalacia during pregnancy greatly benefited by oöphorectomy. A good example of this is the case described by Rasch :²¹⁰ the patient, a multigravida, aged forty-one years, suffered from osteomalacia, which continued after the birth of her twins. As the condition continued to grow worse, the tubes and ovaries were removed, when the patient began immediately to improve, and subsequently became able to walk.

The almost incredible power of resistance which the pregnant uterus displays to interference is well illustrated by a case reported by Vickery :²¹¹ this patient was subjected to medication and operative interference to empty the uterus ; it was supposed that incomplete abortion occurred, and her physician curetted the uterus and applied tincture of iodine followed by injections of hot water. Notwithstanding this treatment pregnancy continued.

The *prognosis* of pregnancy complicated by tumors in cases subjected to operation must be considered as decidedly favorable. Gerdes²¹² gives an interesting account of 16 cases of pregnancy complicated by abdominal tumors ; out of the 16 cases, four perished : all the cases were treated by operation, and many of them in the most radical manner.

5. DISEASES OF THE OVUM.

Under Diseases of the Ovum will be included the disorders of the membranes, the decidua, the placenta, and the funis. The following syllabus presents the topics taken up for consideration in their expressed order :

Amnion :	{ Adhesions and bands, Polyhydramnios, Oligohydramnios.	Placenta :	{ Placentitis, Calcareous degeneration, Fatty degeneration, Apoplexy, Tumors, Syphilis. Anomalies in position, size, weight, shape, and number.
Chorion :	{ Vesicular mole or Myxoma.		
Decidual endometritis :	{ Polypoid, Hypertrophic, Cystic, Catarrhal.	Cord :	{ Coils, Knots, Torsions, Stenosis of its vessels.

A. DISEASES OF THE AMNION.

Amniotic Adhesions and Bands.—Adhesions between the fetus and the amnion, supposed to arise from an arrest of development, are occasionally met with. As the amniotic fluid increases the adhesions are elongated, forming bands. They cause certain deformities, as webbed toes and fingers. Rarely, an amputation of a fetal limb results. When the bands and adhesions are accompanied by a deficiency of the amniotic fluid (oligohydramnios), they are regarded as the cause of malformations of the lower extremities, because the fetus cannot preserve its normal attitude, and it is therefore subjected to injurious compression, resulting in deformities.

Polyhydramnios, or dropsy of the amnion, is an excess of the amniotic fluid. When this fluid is in marked excess of two quarts, polyhydramnios may be said to be present. Cases are recorded where more than twenty quarts existed. This condition is found more frequently in multiparæ than in primiparæ—23 to 5; more frequently in twin pregnancies of the same sex than in single pregnancies. In some cases of twins one sac contains an excess of fluid, while the other sac contains less than the usual amount. This condition has been found in extra-uterine pregnancy.

Two forms of polyhydramnios have been described, the *acute* and the *chronic*. In the former the accumulation of the fluid is very rapid, producing fever. In the latter the fluid increases slowly, and the uterus thereby tolerates its pressure to a greater extent. This condition is sometimes dangerous, because the centrifugal pressure conduces to a critical tensity of the uterine walls, threatening rupture. In labor the sudden free exit of the fluid favors malposition of the fetus, and especially prolapse of the umbilical cord.

Pathology.—The pathology of polyhydramnios is most obscure. This disease has been attributed to a defective maternal cardiac action, permitting transudation of serum from the maternal blood through the fetal membranes. Inflammation of the amnion (amniotitis) has been held as a cause. To great activity of the renal function of the fetus it has also been attributed. There is no settled opinion at present as to its causation. A recent author states that there is a frequent and an undeniable connection between polyhydramnios and the insertion of the placenta in the inferior part of the uterus. The blood-stasis resulting from such a low insertion favors osmosis into the amniotic cavity.

Symptomatology.—The unnaturally rapid increase in the size of the uterus is the most striking symptom of polyhydramnios. The uterus at five months becomes as large as it should be at term. Fluctuation becomes a conspicuous symptom, even to the point of utterly obscuring the presence of pregnancy. Obstetric auscultation and palpation are easily rendered nugatory. Pressure-symptoms relating to circulation and to respiration become especially urgent. Vaginal examination reveals a nearly or quite obliterated cervix and a resilient mass filling entirely the pelvic inlet.

Treatment.—Induction of labor is demanded in the acute form, but in the

chronic form only when the pressure-symptoms become urgent. It has been recommended to cautiously draw off the excess of fluid with an aspirator. Two things must be guarded against: first, the malposition of the fetus and precipitate labor; second, a post-partum hemorrhage, which is so liable to result from uterine atony after over-distention.

Oligohydramnios means a deficiency of the amniotic liquid. Its pathology is unknown. Adhesions and bands are frequent in this condition. It cannot be detected prior to delivery; it is revealed at that time only. Fetal malformations are frequently encountered in oligohydramnios. The fetus is subjected to an abnormal pressure which results in deformities. Webbed toes and fingers are alleged to arise from this condition. Amputation of a fetal extremity may follow the abnormal deficiency of fluid. Malformations of the inferior extremities are ascribed to this complication.

B. DISEASES OF THE CHORION.

Vesicular Mole (Cystic mole; Hydatidiform degeneration of the chorionic villi; Dropsy of the villi of the chorion; Myxoma of the placenta; Molar pregnancy).—The villi of the chorion occasionally undergo myxomatous degeneration, which produces a vesicular mole. The mole is a mass of pedunculated vesicles resembling in appearance grapes or gooseberries. There may be as many as five or six thousand of such vesicles. The vesicles vary in size from a millet-seed to that of a filbert, and they contain a fluid, usually colorless, transparent, liquid as water, holding albumin in solution. Rarely the fluid is reddish in color. If all the villi of the chorion are involved in the degeneration, the life of the ovum is always sacrificed. If only a small portion of the villi are involved, the life of the ovum is not necessarily destroyed and development to term may proceed. In twin pregnancies one chorion may undergo myxomatous degeneration while the other ovum may proceed to full development and be born at term. Often in double pregnancy the development of a cystic mole in one chorion seriously compromises the life of the other ovum, resulting in a miscarriage. Vesicular mole is very rare. One author reports only one case in over twenty thousand deliveries. It is oftenest found in multiparæ of from twenty-five to forty years of age. Numerous recorded cases of women who have repeatedly developed vesicular moles exist; one case developed this condition in eleven pregnancies.

Pathology.—An endometritis is generally supposed to be the factor predisposing to the development of a molar pregnancy. The villi of the chorion undergo hypertrophy and myxomatous degeneration. Three cases have been reported wherein the chorionic villi grew so rapidly as to penetrate the uterine wall even to the peritoneal covering, rendering successful removal impossible without a fatal hemorrhage or a subsequently fatal peritonitis.

Symptomatology.—Three symptoms characterize molar pregnancy: first, an abnormally rapid increase in the size of the abdomen; second, uterine hemorrhage; and third, the expulsion *per vaginam* of the vesicles of the mole.

It may be possible to feel the grape-like masses through the cervical canal. Exsanguination of the patient and septic infection are the chief dangers. As a rule the fetus dies. Rarely, a bunch of the vesicles may be expelled without the course of the pregnancy being interrupted.

Treatment.—No active interference is demanded until the hemorrhages occur. If they are small, rest and an opiate may suffice. If severe, the uterus must be dilated and very carefully curetted, subsequent hemorrhage being prevented by an intra-uterine tampon. The possibility of the growth having penetrated and thinned the uterine wall makes it necessary to use the curette cautiously to prevent perforation of the uterus.

C. DECIDUAL ENDOMETRITIS.

One of the commonest diseases of the ovum is *decidual endometritis*. Four varieties of this disease are described to-day: the polypoid, the hypertrophic, the cystic, and the catarrhal. The names of the different varieties indicate the predominating characteristic of the endometritis. In catarrhal endometritis the discharge of a watery fluid is so abundant as to receive the name *hydrorrhea gravidarum*. It may occur as early as the third month, but usually it is not encountered until the last months of pregnancy. It is more frequently seen in multiparæ than in primiparæ. It is found upon close observation to be a mucous secretion rather than the yellowish amniotic fluid; the latter is further differentiated by containing urea. The sudden appearance of the fluid in a large quantity is generally mistaken for premature rupture of the membranes. In most instances it is repeated several times before delivery occurs. Should pains follow, quietude and an opiate are indicated.

The etiology of *hydrorrhea gravidarum* is obscure. It has been attributed to syphilis, to overwork, to an exaggeration of a pre-existing endometrial inflammation, to gonorrhea, and to an infection following the death of the ovum, to be followed sooner or later by a miscarriage. The frequency of miscarriage from an old endometritis is a well-known fact in obstetric observations.

The treatment of this malady during pregnancy is absolutely *nil*. All that can be done for it must be done in the intervals between gestations.

D. DISEASES OF THE PLACENTA.

Placentitis, inflammation of the placenta, is a very rare disease. Its origin is very obscure, but it is supposed to start from the decidual tissue or from the larger fetal arteries. It soon terminates in induration, oftentimes resulting in strong adhesions between the placenta and the uterine wall, constituting the *adherent placenta*. Apoplectic infarcts are often found in placentitis.

Calcareous Degeneration (Placental calculi; Ossiform concretions; Placental ossification).—By this term is meant the deposits of lime on the edges of the cotyledons or in their substance in the shape of particles of sand or of needles or of scales. They consist of amorphous carbonates and phosphates

of lime and magnesia. The presence of these secretions is without therapeutic significance, and has no ill effect on the functions of the placenta; so many as five hundred have been found in one placenta.

Fatty Degeneration.—A fibrous, followed by a fatty, degeneration of placental villi is of very common occurrence, especially toward the margin of the placenta. When it involves a small area no serious interruption of the function of the placenta follows. When a large area is involved the death of the fetus occurs. The *etiology* of this condition is unknown. A fibrous degeneration, undoubtedly the condition denominated by the earlier writers "aclerases," or "scirrhus" or "cartilaginous degeneration" is regarded as the precursor of fatty degeneration, because it diminishes the blood-supply, which leads directly to fatty degeneration, or, in some cases, to amyloid degeneration. The *diagnosis* of this condition is quite impossible during pregnancy.

Apoplexy.—Blood escaped from a ruptured blood-vessel and occupying circumscribed cavities formed in the tissue of the placenta is called "placental apoplexy." It is occasioned, as a rule, by the rupture of some of the maternal blood-vessels. The effused blood rarely comes from the placental vessels. The clots vary in size from that of a millet- or a hempseed to that of a pigeon egg. Usually there are several clots, a large number being twenty or more. They are situated at various depths in the substance of the placenta, from the fetal to the uterine surface, upon which some of them have a small and irregular orifice. Owing to the spongy nature of the substance of the placenta, the normal condition of the tissue is disturbed only a few lines from the boundary of the cavities. The effused blood soon separates into two parts, one solid, the other liquid. The serum disappears by osmosis, while the solid part contracts, becomes denser and smaller, and loses its color. These whitish homogeneous masses have been denominated concrete pus or tuberculous matter. Cutting into the cotyledons of a placenta often reveals apoplectic clots in the various stages of chronological consecutive changes.

The *results* of placental apoplexies depend upon the period of gestation in which the hemorrhages occur, and upon their number and the extent of territory invaded. Abortion or premature labor is rarely produced. If the infarcts are small and few in number, the gestation will be completed and the fetus will continue to live, its nutrition suffering little or not at all. If, however, the effusions are large and numerous, the offspring will be born feeble, puny, and emaciated. If the apoplectic attacks recur at short intervals, there will occur a progressive diminution of fetal motions and heart-pulsations until they cease altogether. In all cases of a dead-born fetus placental apoplectic infarcts should be sought after carefully. It is by no means rare that women miscarry repeatedly from this cause, and when they do complete their gestations their placentas will be found to contain a number of effusions, both old and recent.

Symptoms and Treatment.—The occurrence of placental apoplectic infarcts

rarely betrays itself by any recognized symptoms, provided the hemorrhage is limited in amount. In some cases there may be present indications of internal hemorrhage, whose occurrence will be suspected, chiefly in women who have experienced this condition in previous gestations and in whom placental apoplexy was found. Should placental apoplexy be suspected, especially in women predisposed to the affection, the prophylactic treatment of uterine hemorrhage is indicated. Absolute rest, small phlebotomies, and saline cathartics, repeated *pro re nata*, are the most rational treatments.

Tumors.—Both solid and cystic tumors of the placenta have been described. They are very rare. They may originate in the meshes of the cellular tissue or in the glandular cavities of the decidua serotina. Solid tumors may cause death and expulsion of the fetus, while the placenta may remain for weeks and even months before being expelled. The presence of tumors can be determined only after delivery, for there are no known symptoms indicating their presence.

Syphilis.—Syphilis of the placenta is a well-established condition. The observations of Fränkel are classic, and comprise all that is fully settled, to-day, upon this subject. The appearances of the placenta with syphilis derived from the father differ from those of the placenta with syphilis derived from the mother. In the former the fetus is diseased and the villi are filled with fatty granulations, their vessels are obliterated, and their epithelial coverings are thickened or absent. In the latter there may be present one of three conditions, which vary according to the time of infection:

1. If the mother be infected during the generative act at the same time as the fetus, syphilitic foci will often develop in the maternal placenta (placental endometritis).

2. If the mother is syphilitic before conception or becomes so shortly after, the chances of the placenta remaining healthy are about even.

3. If the mother is not infected until after the seventh month of pregnancy, both fetus and placenta escape entirely.

A syphilitic placenta is heavier, larger, and paler than normal. Its general color is pale red, but in its diseased parts it is yellowish-white. Here and there the tissue is firmer, more resistant, compact, and friable than normal placental tissue.

Anomalies of the Placenta.—The more important anomalies of the placenta are anomalies in *position, size, weight, shape, and number*. At the end of pregnancy the placenta is normally situated at the fundus of the uterus, anteriorly or posteriorly; it is from 2 to 3 centimeters (1 inch) thick at its central portion and from 17 to 18 centimeters (7 inches) in diameter. It weighs about one pound.

The abnormal position of the placenta of greatest clinical importance is placenta prævia, by which is understood a situation of the placenta in any portion of the lower uterine segment—that is, in that portion of the uterine body which is dilated during the progress of labor.

The size of the placenta is exceedingly variable; sometimes it is very thin

and correspondingly large. This abnormality is most remarkably exhibited in the so-called "placenta membranacea," a placenta formed by the hypertrophy of the entire chorion, the normal atrophy of the chorion leve not occurring. The placenta is frequently enlarged by edema when there is dropsy of the amnion from either local or general causes. An increase in weight of the placenta usually, although not always, accompanies an increase in size.

The variations in shape are of interest, and the anomalies of number are of great clinical importance. The shape is usually round; it may be very irregular, one or more lobes being more or less developed, when the names placenta duplex, tripartita, multiloba, etc. are applied (Pl. 22, Figs. 1-3); it may be oval, as is quite frequent in the so-called "battledore placenta" (Pl. 22, Fig. 6); it may have a horse-shoe or crescentic shape.

The anomalies of number are of greater clinical importance than the variations in size and shape. The danger of accessory growths lies in the possibility of one or more of these growths being retained in the uterus and undergoing decomposition with the production of septic infection. When these accessory placental growths serve as a channel of communication between the blood-sinuses of the decidua and the main placental growth—in other words, when they are functionally active in carrying nutriment to the growing fetus—they are called "placentæ succenturiatæ" (Pl. 22, Figs. 4, 5). Placentæ spuris are analogous accessory formations whose villi have no direct communication with the maternal blood.

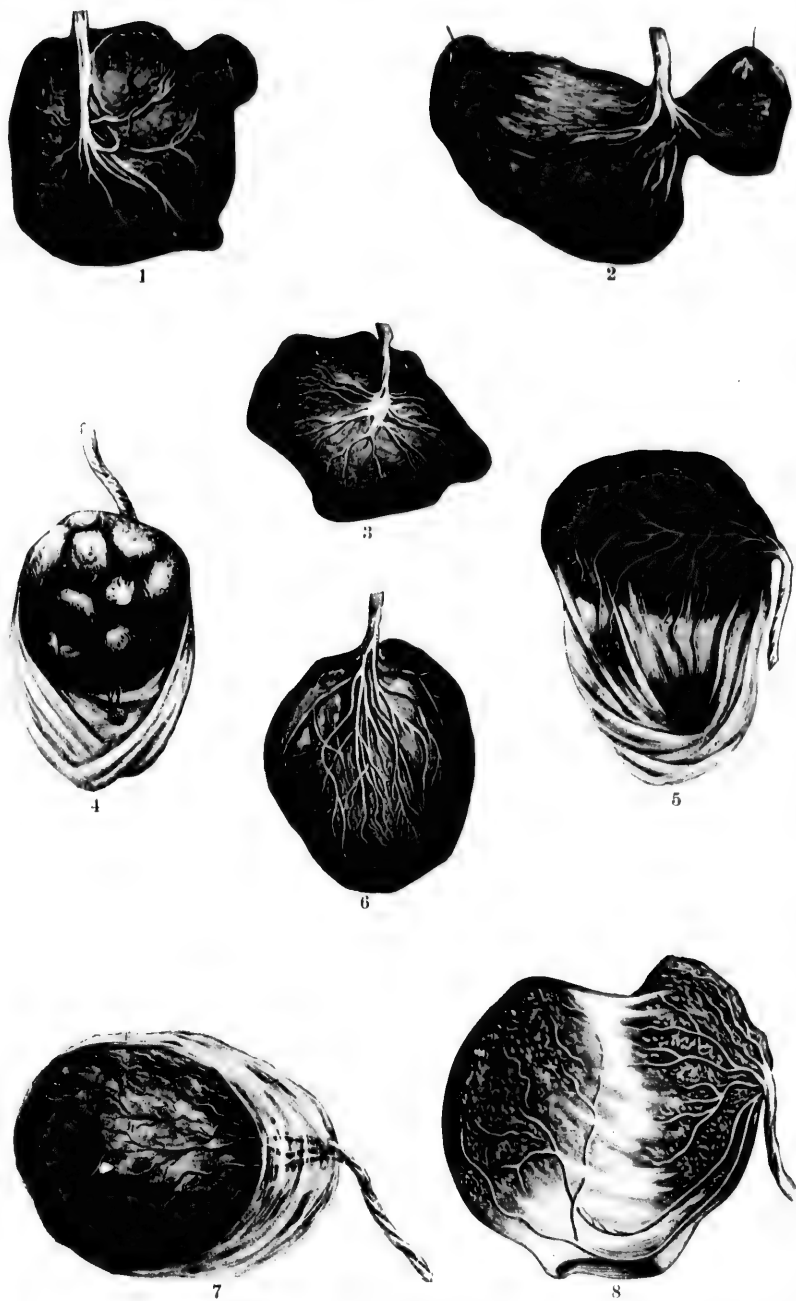
E. ANOMALIES OF THE CORD.

Coils.—One or more coils of the funis may be around the body of the child or around one or more of its members. The neck is the part most commonly encircled. As many as eight coils around the neck have been reported. They are found more often with male than with female children. They occur more frequently in multiparæ than in primiparæ. Their injurious effect is to produce sufficient constriction of the vessels to result in fetal death.

In cases where the coil passes over the portion of the fetus lying against the anterior wall its presence can sometimes at least be inferred by the detection in it of a murmur which is synchronous with the fetal heart-sound. A positive diagnosis cannot be established before labor.

Coils are found at least once in five or six deliveries. In breech presentations and when around the neck they are the most dangerous to the child. Cases of amputation of the members by the pressure of the cord coils have been reported, but it is generally thought that these amputations result from amniotic bands rather than from coils of the cord.

Knots.—When the cord is abnormally long or the liquor amnii very abundant, knots in the cord are liable to be found. They may be double or be single. One case is reported where five knots were found. In recent knots the Whartonian jelly is not displaced, the cord diameter being normal. In old knots the jelly is displaced, and the diameter of the cord is decidedly lessened in the knot. Ordinarily the circulation in the cord is not molested,



ANOMALIES OF THE PLACENTA: 1. Placenta with irregular lobes (Auvard). 2. Placenta in two unequal lobes (Auvard). 3. Irregular placenta (Auvard). 4. Small accessory placenta (Ribemont-Lepage). 5. Placenta succenturiata (Ribemont-Lepage). 6. "Battledore" placenta, oval (Auvard). 7. Placenta with velamentous attachment of cord (Ribemont-Lepage). 8. Placenta with two equal lobes (Ribemont-Lepage).

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but occasionally the knot is so tightly drawn as to cause fatal fetal asphyxia. One case of twins is reported where a hard square knot that united both cords was found, resulting in the loss of both children.

Torsions.—In the vast majority of cases the cord is twisted upon itself from left to right; the cause is unknown. Torsions are likely to be very numerous when fetal death has occurred several days before delivery, are commoner in male than in female children, and are most numerous near the two extremities of the cord. In some cases the jelly of Wharton is wanting at the twisted points, and the life of the infant is endangered from embarrassment of circulation. Complete atresia of the cord and death of the fetus may follow.

Stenosis.—Independently of knots and torsions, narrowing of the vessels of the cord may occur, usually in the vein near the placenta. The causes of these stenoses are believed to be syphilis and atheromatous degeneration. But one eventuation succeeds the development of such stenosis, and that is the death of the fetus.

6. ABORTION.

Definition.—In a general sense by "abortion" is meant the interruption and termination of pregnancy by the expulsion of the ovum before the end of the twenty-eighth week, or the seventh lunar month of gestation. In a more restricted sense the term is used to denote the expulsion of the ovum prior to the complete formation of the placenta—that is, before the end of the twelfth week, or the third lunar month—"miscarriage" being the term applied to expulsion of the ovum from the twelfth to the twenty-eighth week. Expulsion of the fetus between the twenty-eighth week and a short period before full term is designated "premature labor." A goodly number of cases are recorded where fetuses have been born alive between the fourth and seventh lunar months, the greater number living a few hours only, while several six months' fetuses lived and were successfully reared.

Another classification of abortion sometimes used is that which divides the subject into "ovular abortion," occurring before the twentieth day, "embryonic abortion," occurring between the twentieth and the ninetieth day, and "fetal abortion," occurring between the twelfth and the twenty-eighth week.

Frequency.—Statistics as to the frequency of abortion are necessarily incomplete, and therefore unsatisfactory. Very many abortions take place, especially during the first three months of pregnancy, that do not come to the knowledge of the physician, and it is fair to presume that prior to the third month an immense number occur which are not even suspected by the patients themselves. The actual number of abortions, therefore, must largely be in excess of estimates based upon statistics of observed cases. The relative frequency of abortion to labor at term has been estimated variously by different authors as 1 : 5½ and 1 : 8, while the relation based upon hospital statistics has been placed at from 1 : 75 to 1 : 80. According to some investigators, from thirty-five to forty out of one hundred mothers, to their own knowledge, have aborted at least once before their thirtieth year.

Time of Occurrence.—Abortions occur most frequently during the first, second, and third months of pregnancy, when the ovum is usually thrown off *in toto*. The throwing off of the ovum so frequently at this period is due in part to the great vascularity of the uterine mucous membrane at this time, in part to the feeble attachment of the undeveloped chorionic villi to the decidua, in part to the space existing between the chorion and the decidua reflexa (this latter allowing of the easy accumulation of blood between the membranes), as well as to the inability of the ovum at this early stage to offer sufficient resistance to disease-processes. The changes incidental to placenta-formation is no doubt also an important factor in the production of abortion at the third and fourth months. Abortion is more apt to take place upon the days corresponding with the menstrual periods. The disposition to abortion diminishes after the fourth month, as the placenta becomes more fully developed and the connection between the ovum and uterus becomes stronger, and the uterus adjusts itself to the new order of things.

Etiology.—Abortion is the direct result either of fetal death or of uterine contractions. The causes which result in fetal death or in uterine contractions are usually subdivided into those referable to the *father*, to the *mother*, or to the *fetus*, and may be either *predisposing* or *exciting*.

Exciting causes, either alone or in connection with some predisposition, act quickly and more directly upon the uterus or the ovum. Such are violent coitus, blows, falls, contusions, the jarring of railroad travel, missteps, running of a sewing-machine, lifting of heavy weights, rapid stair-climbing, sea-bathing, stretching of the arms above the head, etc. Abortion produced for therapeutical purposes will be treated of in another section.

Exciting causes are generally only active in the presence of the predisposing ones, while many of the predisposing causes remain inactive except in connection with some exciting cause. We cannot, as a rule, say in a given case what will and what will not produce abortion, for on the one hand there are many notable instances where pregnancy has been terminated prematurely by the mildest of exciting causes in the apparent absence of any predisposition, and on the other hand where the most serious traumatism in the presence of a demonstrable predisposition has failed to produce abortion.

Paternal Causes.—A syphilitic father may produce syphilis in the ovum without necessarily infecting the mother. Other causes on the part of the father are extreme youth and old age, debauchery, and feebleness.

Maternal Causes.—Systemic, recurrent, or so-called "habit" abortion is probably due not so much to a maternal constitutional predisposition, the result of habit, as was once believed, as to a continuance of the original cause. *Tuberculosis* and *syphilis* of the mother may destroy the fetus by transmission of these diseases either to the placenta or to the ovum, or simply by lowering the mother's vitality. Syphilis is responsible for most recurrent abortions. The *acute infectious diseases* kill the fetus either by the direct action of the poison transmitted through the placenta, by the action of high temperature, or by the tendency to placental hemorrhage produced by the disease-process. Diseases

of the *heart, lungs, liver, and kidneys* destroy the fetus by producing passive congestions in the placenta.

An excess of carbonic acid gas; chronic lead-poisoning; convulsive diseases, such as chorea, eclampsia, epilepsy; excessive vomiting and coughing; an irritable nervous organization and the habits associated with the extremes of social life; excessive physical exertion, fright, anxiety, and other emotional excitements,—are all more or less potent factors in the causation of abortion. Hot sitz- and foot-baths tend to produce abortion by dilating the pelvic blood-vessels, in this way causing an excessive amount of blood to be sent to the uterus.

Among the local causes may specially be mentioned subinvolution, acute and chronic inflammatory diseases of the uterus and its appendages, as well as tumors, displacements, adhesions, and degenerations. *Endometritis* and *retroflexion* are particularly prone to act as inciters of uterine contractions. Adhesions of the uterus to adjoining organs, as well as tumors of the uterus and in its vicinity, contracted pelvis, and tight-lacing, occasionally cause fetal death by impeding the development of the uterus. While *surgical operations* of the most serious nature have been performed on the uterus and other pelvic organs during pregnancy without in any way influencing the ovum, operations of a minor kind upon distant organs have produced abortion.

Fetal Causes.—Any morbid condition of the ovum or its appendages that endangers the life of the fetus is liable to bring about premature expulsion of the fetus. Syphilitic disease of the membranes and the placenta is a frequent cause. Among other causes may be mentioned hydrorrhea, cystic degeneration of the chorionic villi, placental apoplexy, and the various degenerations of the placenta; abnormal relations of placenta, especially placenta prævia; too short a cord and the knotting of the cord. Death of the fetus may be brought about by disease transmitted from or through the mother, such as syphilis, small-pox, and other infectious diseases, and rarely tuberculosis.

Pathology.—Hemorrhage from rupture of the utero-placental vessels usually takes place in the decidua vera, but the blood is often forced between the decidua and the chorion. Occasionally hemorrhage breaks through the decidua, and even through the amnion and into the amniotic cavity, filling the sac with blood. Uterine contractions separate the chorionic villi from the decidua reflexa from above downward, and the detached ovum is forced into and through the dilated and thinned cervical canal. The decidua vera is usually the last to be expelled, and it is this that most frequently remains long after everything else has been discharged, owing to the inability of the undeveloped uterine musculature to entirely throw it off. The decidua reflexa may be torn, leaving the other membranes intact, the chorion, amnion, embryo, and amniotic fluid being expelled first, followed by the rest. Rarely, the chorion ruptures with the decidua, leaving the amnion intact, either entirely free from other membranes or perhaps covered at one point by chorion and decidua.

Occasionally, owing to the rigidity of the external os, especially in primipare, the ovum becomes fixed in the cervical canal, and it may remain there

a long time unless relieved by incision. The term "cervical pregnancy" has wrongly been applied to this condition. The appearance of the extruded mass (Figs. 147, 148) differs according to the causes, the time, and the duration of the abortion, but, as a rule, in the early months the ovum will be found imbedded in a large blood-clot, the coagulum arranged in layers corresponding with successive hemorrhages. When blood-clots are formed at different times between the membranes, there results what is designated a "blood mole." If the coloring matter has been absorbed from these clots, the mass is called a "flesh mole."



FIG. 147.—Specimens from New York Hospital Cabinet, showing the conditions in which ova are found.

The fetus is usually much smaller than it would be at the same time under normal conditions, especially where the cause has been slow-acting. Sometimes the fetus can be recognized only by aid of the microscope, or it may have entirely disappeared after maceration in the liquor amnii. After partial maceration in the liquor amnii the retained fetus may dry up, and finally be expelled in a mummified condition, or, putrefactive changes setting in, it may be expelled piecemeal.

Clinical History.—In a simple, uncomplicated case of abortion occurring before the third month of gestation the patient, with very little if any warning, has a more or less profuse, generally continuous, hemorrhage from the uterus. After a variable period, more or less severe, regularly recurring modified labor-pains occur, due to uterine contractions. Under the influence of the uterine contractions the cervical canal is expanded, the external os is dilated, and the ovum is either forced out entire, imbedded in a large clot,



FIG. 148.—Ovum imbedded in blood-clot (Ahlfeld).

or the embryo is first expelled, followed shortly by the already loosened membranes. During the third and fourth months, owing to the more rigid

condition of the cervix and external os, the pains become more severe, more force being required of the uterus to overcome the resistance of these parts. Owing to the firmer connection of the ovular to the uterine surfaces, more force is also necessary for detaching the membranes, and, as the uterine muscle is still undeveloped, a greater length of time is taken to complete the abortion. The amniotic sac in these cases usually ruptures before the complete separation of the membranes; the fetus is expelled, generally with a portion of the membranes; and the remaining portions are finally entirely detached and forced out of the uterus. After the fifth month the process more and more resembles labor at term.

The above outline of the clinical progress of simple, uncomplicated abortions occurring before and after placental formation probably does not represent the class of cases usually coming under the physician's care. It will be well on this account to consider briefly the more common symptoms and variations in detail.

Prodromal Symptoms.—Reliable symptoms and signs indicative of approaching abortion very rarely exist before the third month, and they are not constant after that time. The occurrence of shifting pains in the back and abdomen, frequent urination, sometimes nausea and vomiting, and a mucous or watery discharge from the uterus should be a warning of the possibility of approaching abortion, and early and appropriate treatment should be instituted.

Duration of Abortion.—The duration of the abortive process varies according to the period of gestation, the cause of the abortion, and the condition of the os and cervix and the energy of the uterus. As a rule, abortion is slower than normal labor at term. Especially after a fall the ovum, in the earlier period of its development, may be thrown off and expelled instantaneously, or it may rapidly be expelled after a few gushes of blood and a single painful contraction. These cases, however, are but rarely observed.

Hemorrhage and Pain.—In early abortion hemorrhage is the leading symptom, and it is the first that attracts attention in the majority of cases. It is often excessive and alarming, and may be so profuse as to endanger the mother's life. Hemorrhage may precede pain many hours or even days and weeks, or in rare cases it may take place conjointly with pain. It may be very slight at first, cease after a variable period, and then recur, or it may begin with a sudden profuse discharge. Hemorrhage may take place continuously from the uterine surface, but it may only appear at intervals externally in the shape of clots, sometimes collecting in the uterus in considerable quantities before being expelled. This "concealed hemorrhage" rarely happens before the fourth or the fifth month of gestation. The amount of blood lost varies considerably with the period at which the hemorrhage occurs, being, as a rule, less the nearer the abortion is to the end of pregnancy, and it depends to a considerable degree upon the extent of separation of the ovum from the uterine wall, as well as upon the activity of the uterine contractions. Generally the hemorrhage will continue until the uterus is empty. Hemorrhage

is sometimes preceded in these cases by the passage of small quantities of dark-colored blood-serum.

The pains of abortion, which resemble those of labor at term in many instances, vary considerably according to existing conditions. Many patients complain that abortion-pains are harder to bear than those of normal labor, and not so easily forgotten. In exceptional cases the pains may begin some time prior to the occurrence of hemorrhage.

Expulsion of Uterine Contents.—Instead of the membranes and the placenta being expelled with the fetus or shortly afterward, a portion or all of the placenta may remain behind, either only partially or wholly detached from the uterine wall, constituting what is designated "incomplete abortion." There may be considerable delay before the remnants are entirely expelled, the process of unaided expulsion requiring days, weeks, and even months, for completion. So long as any portion of the ovum or its coverings remains in the uterus, just so long will the patient be subjected to the risk of hemorrhage and sepsis. Frequently after several days there is a return of hemorrhage and pain, with slow dilatation of the external os, and the decomposing uterine contents come away piecemeal.

Sometimes in twin pregnancies symptoms of threatened abortion will subside without rupture of the membranes, and the pregnancy will continue to term, at which period a living child will be born, and at the same time a dead fetus or "blighted ovum" will be expelled.

Diagnosis.—While there is, as a rule, but little doubt as to the existence of abortion in the majority of cases coming under the physician's care, it is nevertheless true that there are cases where it is quite impossible to make a positive diagnosis, and others in which the diagnosis can only be arrived at after a searching examination into the history of the case, a careful analysis of the symptoms, and a thorough physical exploration.

Where the entire ovum is expelled suddenly, as sometimes happens in early pregnancy after falls or blows, and the expelled mass is either lost or thrown away without being examined, a positive diagnosis is not possible.

In dealing with a case of uterine hemorrhage and pain, unless there be sufficient evidence of its cause, the first point to determine is as to the *existence of pregnancy*. In the early months of gestation this determination may be impossible, and in the absence of positive signs we can only presume that pregnancy does or does not exist. It may be denied by those who may have an object in denying it, or it may be admitted by those who simply believe themselves to be pregnant. Abortion may be simulated in the non-pregnant woman by dysmenorrhea, by pain and hemorrhage caused by the presence of submucous uterine tumors, and may even be feigned by hysterical girls at the menstrual period or by women with intention of blackmail. In the absence of a history of previous attacks of dysmenorrhea, and of a record "running over" two or three months, a vaginal examination should be insisted upon, which examination, with that of the napkins, would probably settle the diagnosis one way or the other. A careful inquiry into the patient's history, together with

physical exploration and examination of the discharges, will assist in clearing up doubts in the case of hemorrhage and pain from uterine tumors. The examination of membranes, clots, and pieces of tissue offered in evidence as to abortion will expose any attempt at malingering.

Having determined that pregnancy exists in a case of suspected abortion, the next thing to be determined is whether we have to do with abortion or with something simulating it. Abdominal pain and uterine hemorrhage occurring at the same time in a woman supposed to be pregnant is presumptive evidence, at least, of impending abortion, but such evidence alone is not sufficient for a positive diagnosis. For instance, hemorrhage may take place from a diseased cervix in pregnant women, and at the same time there may be present intestinal colic, neuralgia, stretching of old visceral adhesions, or the discomfort of an over-distended bladder. Nor is the presence of membrane always positive evidence. In extra-uterine pregnancy the expulsion from the uterus of a deciduous membrane, together with more or less hemorrhage, may lead to a wrong diagnosis of abortion. In the latter case the absence of chorionic villi will count against the case being one of abortion.

Pregnancy existing, and abortion determined upon as the cause of the symptoms, the next inquiry will be as to whether abortion is simply *threatening*, whether it is *inevitable*, or whether it has been *completed*. In *threatening abortion* the os uteri is undilated, the cervical canal is unexpanded, the hemorrhage is not profuse, and the pains are easily controlled. In *inevitable abortion* the os is usually dilated sufficiently to admit the index finger, the cervical canal is expanded or expanding, the angle between the upper and lower uterine segments is effaced, the uterine contents are forced down within reach of the finger with each pain, and the hemorrhage and pains cannot be controlled; or profuse hemorrhage alone, if uncontrollable, may be sufficient evidence of inevitable abortion. A critical examination of the discharges from the uterus by floating them in water will often determine whether or not the integrity of the ovum has been destroyed, and will thus assist the diagnosis. Abortion is *complete* when the uterus is free from ovular tissue. The continuance of pains or of hemorrhage, or both, is conclusive evidence that the abortion is incomplete.

Prognosis and Sequelæ.—For the child the prognosis is necessarily fatal. As a rule, the prognosis for the mother is remarkably good, better even than after labor at term, a fatal termination rarely taking place except in badly-managed or neglected cases. The danger of general septic diseases is much less after early abortion than later. Even under conditions that would, if existing at the end of pregnancy, prove most disastrous, such as septic intoxication from putrefaction of retained membranes, rapid disappearance of the symptoms is the rule in abortion under appropriate treatment. But while the immediate danger to the mother's life is less than it is at the termination of pregnancy, the pernicious consequences of neglected or badly-managed abortions are far more common, and not nearly so amenable to treatment.

The nature and severity of the sequelæ vary with the causes. Anemia, with great debility, consequent upon excessive hemorrhage at the time of

abortion or upon recurring hemorrhages, the result of subinvolution or of retained fetal membranes, is very frequently observed. Among the more common local results of abortion are acute and chronic inflammatory diseases of the uterus, the ovaries, and the tubes, and of adjacent structures, from a more or less marked septic infection. Such diseases are endometritis, acute cellulitis, pelvic peritonitis, pelvic abscess, salpingitis, pyosalpinx, oöphoritis, etc. Hydatidiform moles, the result of retained chorion, and placental or decidual polypi, the result of retained fragments of placenta or decidua, are often noticed. Secondary infections are not infrequently encountered as a result of abortion. Suppurative arthritis may be mentioned as an example. One abortion nearly always predisposes to recurrences, giving rise to what is known as "habitual abortion," unless the original cause be removed and the abortion be managed in a proper manner.

A most important sequel to abortion is its baneful effect, at times, upon the nervous system. There is scarcely a single manifestation of the so-called "functional nerve disorders," from slight irritability of temper or mental depression to actual insanity, that may not have its origin in a pathological condition the result of abortion. While local irritation alone may be responsible for some of these disorders, the possibility of autoinfection from the slow but continuous absorption of mildly septic material from a chronically inflamed mucous surface should be borne in mind.

Treatment.—In the treatment of abortion we have to consider—1. Prophylaxis; 2. Treatment of threatening abortion; 3. Management of actual abortion and treatment of its accidents; 4. Treatment of incomplete abortion; 5. After-management. Abortion is truly a surgical condition, and its treatment requires and should receive the application of the same well-known principles in regard to the prevention of sepsis as do other surgical affections. Surgical cleanliness is as much indicated in abortion as it is in labor at term.

Prophylaxis.—The prophylaxis of abortion consists in the treatment of all those general and local conditions which predispose the patient to its occurrence, in the restoration of the patient as nearly as possible to normal health before and after conception, and in the avoidance after pregnancy has begun of those exciting causes which are more or less prone to precipitate an abortion, at least in predisposed cases. Local causes, such as tumors in and about the uterus, subinvolution, endometritis and other inflammations, displacements, etc., should be sought for and should appropriately be treated before conception. General pathological conditions, such as tuberculosis, syphilis, anemia, the neuroses, as well as diseases of the thoracic and abdominal viscera, should also receive treatment both before and after pregnancy has begun. As syphilis is probably responsible for a much larger number of abortions than any other single cause, its presence in one or both parents should receive prompt and thorough attention. In those instances where no other cause can be found and there is no indication of syphilis existing in either parent, father and mother should be placed under antisiphilitic remedies, as an apparently cured syphilis may still exist sufficiently to affect the ovum. During preg-

nancy the greatest care should be taken to avoid all possible sources of irritation, such as fatiguing work, too long walks, riding, dancing, lifting, reaching, stair-climbing, jumping, sea-bathing, corsets, tight clothing, contagious diseases, poorly-ventilated or overheated rooms, crowded theatres or crowded churches, emotional excitement, late hours, etc. The diet should be regulated carefully, in order that acute dyspepsia, flatulence, colic, diarrhea, and constipation may be avoided, and the kidneys and the bowels should be regulated properly. Coitus should be prohibited. The patient should, if possible, spend several days in bed at the times corresponding with the menstrual periods. A retroflexed uterus should carefully be righted and be held in position by an appropriate pessary.

In cases of habitual abortion it would be well for the patient to allow an interval of six months or a year to elapse between the last abortion and the next pregnancy while under treatment. In some cases confinement to bed the greater part of the time seems to be the only way in which pregnancy can be carried through to term.

Treatment of Threatening Abortion.—If upon examination the os is found undilated, the cervical canal unexpanded, hemorrhage not profuse, and pains absent or moderate, the case should be considered as preventible and be treated accordingly. If we knew for a certainty that the fetus was dead, there would be no reason for treating the case as preventible, but as there are no reliable signs of fetal death where abortion is only threatening, we must treat it as though the fetus were alive. Our aim is to prevent, if possible, any further separation of the ovum from the uterus, and to allow of the healing of the already injured surfaces. To this end we endeavor to *control hemorrhage and uterine contractions*.

Absolute rest and quiet are essential to the proper treatment of threatening abortion. The patient should be put to bed in the quietest, best-ventilated room in the house. She should maintain a recumbent position for several days or until all danger is past. She should not rise, even to a half-sitting position, for any purpose, the bed-pan being used for defecation and urination. Everything having a tendency to produce nervous disturbance should be avoided, such as talking, visitors, and worry of any kind. Secure free movement of the bowels each day by sufficient doses of castor oil or other mild laxative, aided, if necessary, by enemata of glycerin and water or of sweet oil. The clothing should be cool and light, the diet nutritious and easily assimilated, but non-stimulating.

In the way of *drugs*, opium in one of its forms is mostly to be relied upon as a general sedative. It should be given in full doses, and repeated often enough to preserve systemic quiet. In some cases it may be advantageous to give with the opium such nerve-sedatives as chloral hydrate, the bromids, or phenacetin. These drugs should be given per rectum if the stomach is sensitive. The fluid extract of *viburnum prunifolium* in drachm doses is said to assist materially in quieting uterine contractions. Ergot in small doses (15 to 20 min. of the fluid extract) may be of benefit in selected cases (where there is

little pain, but much hemorrhage) in assisting in the control of hemorrhage by contracting the arterioles, but as a general thing it should not be used, owing to the tendency for even small doses to excite uterine contractions.

The vaginal tampon, as a rule, should never be used in threatening abortion, on account of its action in exciting uterine contractions. In exceptional cases, however, where there is not much pain, but considerable hemorrhage which cannot be controlled by other means, the tampon may be useful in connection with the sedatives already mentioned. A vaginal injection of hot alum-solution (3ss—Oj) may be used instead of the tampon. Any malposition of the uterus should be remedied by the gentlest manipulations.

Treatment of Actual Abortion.—If the os is dilated and the cervical canal is expanded, or the pains and hemorrhage continue notwithstanding treatment, and there seems to be no prospect of checking the progress of the abortion, the expulsion of the ovum becomes inevitable. The main indication now will be to control hemorrhage and to secure complete evacuation of the uterus.

If it has not been done before, the vagina and the external genitals should be placed in as nearly an aseptic condition as can be done with hot water, soap, and an antiseptic solution. The physician's hands and the instruments should also be rendered surgically clean before an examination is made. If the ovum is protruding with membranes unruptured, it may easily be dislodged from the cervical canal, but we should refrain from manipulations that might cause rupture before its complete extrusion.

Before the fourth month we may best meet the indications—to control hemorrhage and to expedite delivery—by the use of a *vaginal tampon*.



FIG. 149.—Sims's position for tamponing and curetting (Skene).

Properly applied, the tampon will surely control hemorrhage; further, it hastens the complete separation of the ovum by causing an accumulation of blood between the uterus and the membranes, and it is a powerful exciter of uterine contractions. The tampon may be made of a long strip of aseptic or antiseptic gauze, of pledgets of aseptic or antiseptic absorbent cotton or wool, or, in the absence of these materials, of any soft fabric, such as a silk handkerchief, a soft towel, or strips or pieces of sheeting, cheese-cloth, an ordinary roller bandage, etc. Whatever material is used, it is understood it must be sterilized thoroughly by boiling, by dry heat, or by steam, or it may be scalded thoroughly in some hot antiseptic solution. If a large number of

pieces are used, as of antiseptic wool, they should be so secured to each other by a string as to facilitate their withdrawal. If the material has previously been prepared or if it can be sterilized by dry heat before using, it is better to use it without soaking in an antiseptic solu-

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tion, as more accurate tamponage can be done when the tampon is dry than when it is wet.

For introducing the tampon the patient should be placed across the bed, or, better, on a table, in the dorsal or in Sims's position, with the hips at the edge of the bed or the table (Fig. 149). A very copious hot-water or hot antiseptic vaginal douche should next be given, after the



FIG. 150.—Frozen section of the uterus, showing placenta and partially-detached membranes (Freund).

bladder has been emptied. The tamponing may be done with the aid of a Sims speculum if assistance is at hand; if not, then a bivalve speculum may be used, or, as is preferred by some, one or two fingers of one hand are introduced into the vagina and there act as a guide. With dressing forceps one end of the strip of gauze or a pledget of the tampon material is passed into the vagina along the introduced fingers, and is accurately packed by

them into, against, and about the os and the cervix. The tamponing should be continued in this way until the vagina has been moderately filled. An antiseptic pad is placed over the vulva and is held in place by a T bandage. Moderate doses of fluid extract of ergot (℥xv to ʒss) should be



FIG. 151.—Frozen section of the uterus, showing retained membranes (Freund).

administered every two or three hours, together with quinin or strychnia where these are indicated for debility. If there is much pain, 5 grains of phenacetin will give the patient comfort without interfering with uterine contractions. A second tampon and other accessories should be in readi-

ness before the removal of the first. The tampon should be removed carefully after from six to twelve hours, when, as is usual, the entire ovum or the fetus alone will be found in the vagina or adhering to the tampon. If the ovum has not been expelled or only a portion has been thrown off, we should tampon again, after emptying the bladder and douching the vagina, in the same manner as before.

If after the removal of the second tampon it is found that the membranes have ruptured, and only a portion, if any, of the ovum has been expelled, the uterine cavity should be explored by the introduction of one or two thoroughly antiseptized fingers, the vagina having first received a thorough cleansing with hot water or with antiseptic fluid. If much pain is to be feared or the patient is nervous and resisting, an anesthetic should be employed. If the os is not sufficiently dilated to admit the finger, graduated metal or hard-rubber dilators should be employed. The introduction of the finger may be aided materially by properly applied counter-pressure on the fundus through the abdominal walls. The cavity of the uterus must be explored thoroughly and the retained portions (Figs. 150, 151) be separated, if adherent, and removed. In case the use of the finger is unsuccessful, the adherent mass should be removed by the careful use of a not too sharp intra-uterine curette. The instrument devised by Carl Braun or one similar to it answers the purpose admirably, being at the same time a curette and an irrigator. Either plain hot water or a hot mildly antiseptic solution of creolin (1 to 2 per cent.) or of boric acid (4 per cent.) or straw-colored tincture of iodine, are recommended for irrigating the uterus, as being the fluids least liable to do harm. In the use of the curette great care should be observed lest more harm be done than the good we seek to accomplish. The dangers to be avoided are perforation of the uterus by careless manipulation, and in needlessly injuring, by indiscriminate curettage, uninvolved mucous membrane. After complete emptying and irrigation of the uterus in this way an antiseptic pad should be placed against the vulva.

The tampon is contra-indicated in abortion after the fourth or the fifth month, as the uterus at this period is sufficiently large to contain considerable blood. For the control of hemorrhage rupturing of the membranes is to be preferred, but if tamponage is resorted to the uterus must closely be watched. The ineffectual uterine contractions usually found may be stimulated by from 5- to 10-grain doses of quinin. If after rupture of the membranes, hemorrhage continues, the uterus must be emptied as quickly as possible, the cervix being dilated if necessary, the fetus be extracted, preferably by turning, and the placenta be removed if detached or easily detachable. If the placenta is firmly adherent, it may safely be left for a few days to become detached by natural means, provided the uterus and the vagina can properly be irrigated antiseptically, the former twice in twenty-four hours, the latter from four to six times or continuously. The insertion into the uterus of an iodoform-gauze tampon has been used successfully in these cases. After the placenta has become detached, it and the remaining adherent fragments may be

removed in the manner already described, either by means of the fingers or the curette.

Treatment of Incomplete Abortion.—If there is, after the apparent completion of abortion, more or less hemorrhage, either continuous or interrupted, with slightly dilated os and flabby cervix, especially if there be pain and an odor of decomposition, it is evident that some portion of the ovum still remains in the uterus.

In the mildest cases, in which there is as yet no infection of the retained portion and the os is contracted, conservative measures might be advisable in those cases that could be kept under observation and in those in which the treatment could properly be carried out. Such conservative treatment would consist in keeping the patient quietly in bed, stimulating uterine contractions by repeated moderate doses of ergot and by the use of the vaginal tampon, and by keeping the vagina and the vulva in a strictly aseptic condition.

In neglected cases, where there is much hemorrhage or pain, and especially if there be even a minimum amount of fetid odor to the lochia as it comes from the uterus, the indications are clearly to empty the uterus completely and at once—with the fingers if possible, with the curette if necessary; to render the uterus and the vagina as nearly aseptic as possible by antiseptic irrigation, and to keep them so. In the treatment of incomplete abortion, whether the case is seen early or late, there should be observed the same rigid adherence to the principles of aseptic or antiseptic surgery as is observed in any other case.

After-management of Abortion.—There is no valid reason why the woman who has aborted should not require as much time for the repair of uterine lesions and for the proper involution of her enlarged uterus as does the woman who has been delivered at term. Owing to the imperfect development of the enlarged uterus after abortion, the process of involution is even slower than the same process after labor at term. There would be a marked decrease in the number of pelvic disorders, and there would be almost as great a falling off in the number of abortions, if women were treated after aborting more nearly as they are after a normal labor.

Missed Abortion and Missed Labor.—As a child at full term may die and may remain *in utero* for weeks or for months afterward, this condition is called "missed labor." A similar condition—missed abortion—is observed in the earlier months of pregnancy when the fetus dies, the ovum remaining *in utero* for weeks or for months. The symptoms of pregnancy are then arrested; the liquor amnii is absorbed, the abdomen becomes smaller, and milk appears in the breasts. The child *in utero*, surrounded by the placenta and the membranes, becomes macerated or mummified. It does not necessarily become putrid, because the unbroken membranes prevent the entrance of atmospheric germs. In these cases labor does not come on at all, or, having commenced, the pains cease and the fetus is retained.

Oldham was the first to apply the term "missed labor" to cases in which

occurred in the liquor to whether access to the condition is somewhat, tion of all parts being uterine wall through the peritonitis, but convalescence and the fetid product it may cause results. Besides may lead to A dead generally seen. Consequently few weeks, and to induce labor caution is safe. When nature active efforts be employed be exercised to cemia. Lapsar very thing to Müller of are really cases expulsion, because it may be said fetation of the fetus in a bilob

History.—E pathology, and sions and has c or twenty years attention. From of many practice not quite unknown

occurred ineffective uterine efforts to expel the fetus and other contents except the liquor amnii. Air does or does not enter the uterine cavity according as to whether the membranes are or are not ruptured. If atmospheric air has access to the fetus, the latter undergoes putrefactive changes, giving rise to a condition known as *physometra* or *tympanites uteri*; the soft parts liquefy somewhat, then escape, leaving the osseous structure. A complete evacuation of all the fetal structures is rarely effected by nature alone. Some of the parts being retained, the projecting bones may penetrate the surrounding uterine walls, and find their way into the vagina, the rectum, the bladder, or through the abdominal walls. A similar action may lead to suppuration, peritonitis, septicemia, and death. Most cases, however, eventually recover, but convalescence is long and very tedious. If air is excluded from the uterus and the fetus is retained, the latter may become mummified, and this mummified product may remain indefinitely without creating special harm. Possibly it may cause irritation, suppuration, and uterine or pelvic abscess and their results. Besides maceration and mummification a prolonged fetal retention may lead to adipoceros changes. Calcification very rarely occurs.

A dead fetus within the uterine cavity, although no air has entered, generally seriously impairs the health and endangers the life of the woman. Consequently, in cases of this kind it is always prudent, after the lapse of a few weeks, and when there is no physical evidence of a commencing expulsion, to induce labor artificially—an obstetrical procedure which under careful precaution is safe, infinitely more so than allowing the dead fetal mass to remain. When nature is successful in partially eliminating some of the fetal portions, active efforts by the hand or by instruments, after cervical dilatation, should be employed to aid the woman. Every known antiseptic precaution should be exercised to prevent or to control hectic symptoms, peritonitis, and septicemia. Laparotomy, laparo-hysterectomy, or a Porro operation may be the very thing to do under certain circumstances.

Müller of Nancy has shown that many cases of so-called "missed labor" are really cases of extra-uterine pregnancy, with ineffectual attempts at fetal expulsion, because of a certain position of the fetal body. With fair propriety it may be said that most of these cases are those of advanced extra-uterine fetation of the intramural (interstitial) or tubal variety, or of retention of the fetus in a bilobed uterus.

7. EXTRA-UTERINE PREGNANCY.

History.—Extra-uterine pregnancy from the standpoint of its etiology, pathology, and operative treatment has provoked such numerous discussions and has called forth so many valuable essays within the past fifteen or twenty years that the historical side of the subject has received but little attention. From this one-sided view the impression has arisen in the minds of many practical men that this anomalous form of gestation was almost if not quite unknown even to our immediate predecessors. A research into the

medical literature of the past four centuries, however, brings to light many clear descriptions of well-recognized cases of extra-uterine pregnancy.

Israel Spach in his extensive gynecological work, published in 1597, figures a lithopedion drawn *in situ* upon a full-length cut of a woman with the belly laid open. He dedicated to this calcified fetus, which he regarded as a reversion, the following curious epigram, in allusion to the classical myth that after the flood the world was repopulated by the two survivors, Deucalion and Pyrrha, walking over the earth casting behind them stones which on striking the ground became people. Roughly translated from the Latin, this epigram reads as follows: "Deucalion cast stones behind him and thus fashioned our tender race from the hard marble. How comes it that now-a-days by a reversal of things the tender body of a little babe has limbs nearer akin to stone?"

We find many of the earliest writers mentioning this form of fetation as a curiosity, but offering no explanation as to its cause. One of the first and most natural suggestions was that the fetus had died *in utero*, and afterward had become displaced into the abdominal cavity, where it excited suppuration and thus was finally discharged.

An important discussion was called forth in 1669 by the case of Benedict Vassal, a surgeon in Corradi, Italy. The great obstetrician Mauriceau's drawing (Fig. 152) of the specimen obtained shortly after the autopsy is remarkably clear, and it well supports his judgment that this was not a tubal pregnancy as asserted. His description of the case is well worth quoting even at this day; translated freely, it is as follows:

"History of a woman in whose abdomen there was found, after death, a small fetus about $2\frac{1}{2}$ inches long, together with a great quantity of coagulated blood.

"The history of this case deserves to be carefully considered to decide whether the fetus, as believed by many, was generated in the ejaculatory vessel, called the tube of the womb. On the sixth of January, 1669, in the village Corradi, I saw in the hands of a surgeon named Benedict Vassal a uterus which he had removed a short time before from the body of a woman aged thirty-two, who had died after three days of the most agonizing pains in the stomach, from which she had fallen into frequent fainting spells and the most violent convulsions. This woman had borne eleven children at term, but in her twelfth pregnancy, at about two and a half months, the womb dilated in the direction of the right horn, and, unable to withstand this distention, ruptured. The fetus was expelled into the abdomen, and was found with a great quantity of coagulated blood among the intestines of the mother. Many physicians, surgeons, and naturalists betook themselves to this surgeon to see the uterus which was exhibited by him as a prodigy, as he insisted that the fetus was formed in the ejaculatory vessel, which Fallopius calls 'the trumpet of the womb.' They accepted at once, without further investigation, that this was just as the said surgeon claimed, and that this case confirmed stories of a like nature narrated by Riolanus. However, I examined the parts of the

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uterus most carefully and minutely, and it was evident to me that those who accepted this opinion had been led into error; for this reason, that at the time I made a drawing of the womb as it then appeared, and this is a more faithful and accurate reproduction than that which this surgeon had engraved upon copper after a month had elapsed, as the uterus then retained almost nothing of its primitive form, and was spoiled by the handling of a thousand men or more who had seen the uterus, pulled it, disturbed it, and turned it inside out that they might examine it.

"Many have adduced this case to prove to us that the testes" [ovaries] "of women are full of little ova which at the moment of coitus free themselves and emerge from the body proper of the testes, and are thence borne into the uterus through the tube, to serve for the generation of the fetus. They claim that one of these so-called ova had by chance remained in the tube of this woman, instead of passing forward into the uterus, and that this was the cause of her death.

"Regner de Graaf among others holds this opinion, for the confirmation of which he brings forward the figure of this uterus, which the surgeon of whom I have spoken had already given to the public; as one finds it on the 260th page of his book on the 'Generative Organs of Women.' Any one

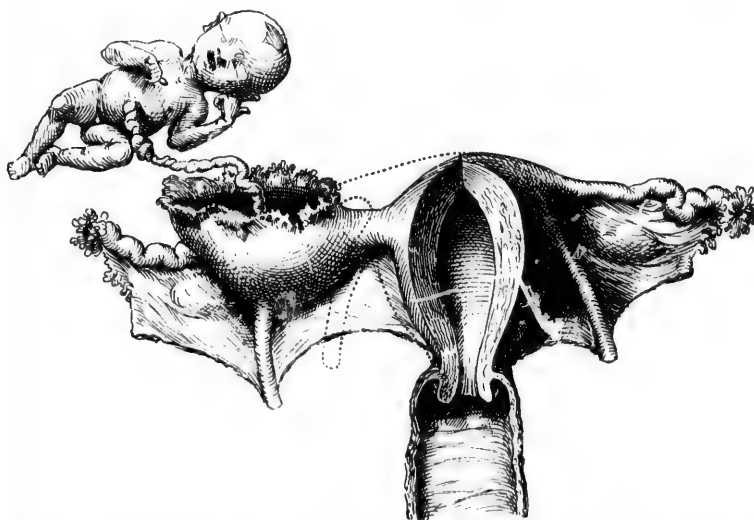


FIG. 152.—Case of extra-uterine pregnancy figured by Mauriceau, redrawn, but practically unchanged. The fetus is here shown attached to the sac, which was not the case in his figure. The distinct neck between the sac and the uterus is evident; the round ligament comes out of the under surface of the sac more toward its outer pole. The relations of a normal uterus are indicated by Mauriceau in dotted lines.

who will examine, carefully and without prejudice, the following figure, which is most faithful and faultless, and at the same time look into our reasons, will find that we have given another demonstration which we believe to be the true explanation."

Mauriceau with great insight then cites the anatomical relation of the round ligaments to the body of the uterus as substantiating his view of the case. He says, "Behold how clearly I demonstrate that this part in which the child was contained was a portion of the body proper of the womb, and not the tuba uterina, and this because the round ligament is constantly attached directly to the lateral wall of the body of the womb, called the cornu, and at this place it becomes fused with the substance of the womb. It is therefore certain that the part where the ligament ended (Fig. 152), and at which it was strongly attached on the right side, where the malformation existed, was a portion of the womb itself; consequently the child was engendered in a part of the womb that was elongated."

It is interesting in this connection to note that Mauriceau, in this differential diagnosis, anticipated some of the results of our latest investigations concerning the differences between tubal and cornual interstitial pregnancy and

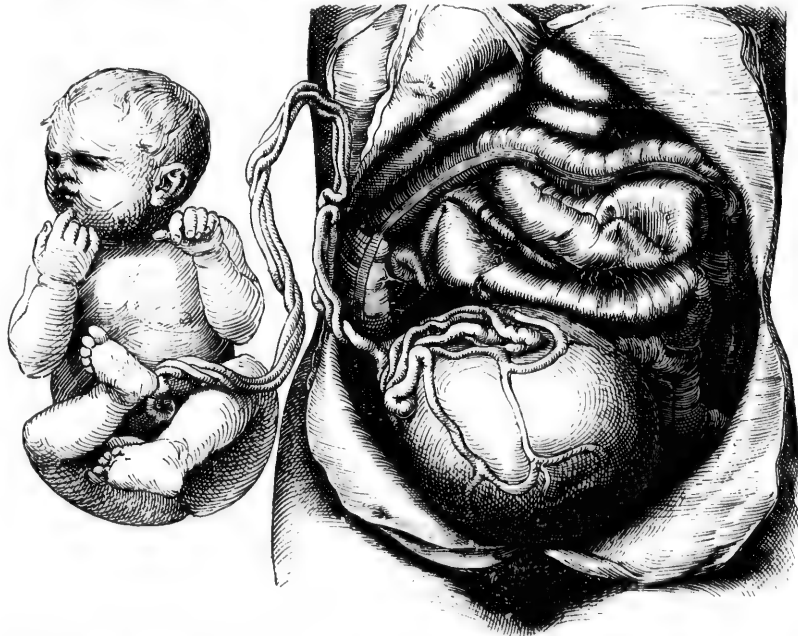


FIG. 153.—Reduced figure of Deutsch's case of abdominal pregnancy (an account of which was published in 1799 with life-size copper-plate engravings).

pregnancy in a rudimentary horn. From the above it is evident that Mauriceau was positive that impregnation had not occurred in the Fallopian tube, but in one cornu of the uterus, and that the ovum had developed as a hernia from the uterus. I find that Regner de Graaf, just as Mauriceau states, accepted the view of Vassal, and in his description of the Fallopian tube reports the case and reproduces the figure from the copper plate which Mauri

seau condemns. De Graaf believed this to be a case substantiating his own theory regarding the function of the ovaries and the Fallopian tube. He says, "We judge that the tubes called Fallopian in women and in every kind of female are true vasa deferentia, or, if you prefer, oviducts, inasmuch as the ova are transmitted through them to the uterus." He further says, "The tube or horn [Fallopian tube] of the womb is dilated and affected by semen corrupted there and seeking an outlet; but it is remarkable that the male semen should reach that point and that a fetus should have been conceived there, as is proved by histories."

De Graaf believed that the ova were fertilized in the ovaries and that they were then carried downward into the uterus, where they remained until the full term of gestation was completed. He does not offer any explanation for the arrest and development of the ovum in the tube; on the contrary, he distinctly states that he does not know why it occurs. He recognized, however, the dangers of this anomalous pregnancy, as indicated by the following statement: "The ovum already fertilized is detained in its transit in the tubes, and by its increase in size brings death to the mother." In his critical remarks upon Vassal's case he says: "And from this our opinion it is not difficult to explain how a fetus occasionally develops in the abdominal cavity among the intestines, inasmuch as the ova already impregnated fall from the testes" [ovaries] "outside the cavity of the tubes and are nourished by the neighboring parts."

From these references to the earlier literature it will be seen that ectopic gestation was clearly recognized, its symptoms graphically described, and the theories advanced those that are accepted by many writers of the present day.

Numerous other contributions are found in the literature of this subject, following De Graaf and Mauriceau, one of the most interesting being figured in the obstetrical work of Peter Dionis of Paris, published in the early part of the eighteenth century.

Even so early as 1741, Bianchi constructed an elaborate classification of the forms of extra-uterine pregnancy, that was simplified by Boehmer in 1752, who described three forms—"gestatio ovarica," "gestatio tubaria," and "gestatio abdominalis." From the time of Boehmer a period of forty-nine years intervened in which this classification remained practically unchanged. In 1801, Schmidt described the interstitial form of ectopic gestation, and with this addition Boehmer's classification must practically be accepted even at the present day, with the exception of a primary abdominal form.

Etiology.—No entirely satisfactory conclusions have yet been reached regarding the cause of this anomalous form of pregnancy. Among many theories none have been demonstrated. One great difficulty lies in the fact that it has not yet been determined at what point in the female genital tract normal impregnation of the ovum takes place, and until this question is settled the primary question, whether extra-uterine fetation is an abnormal ectopic impregnation or is simply a detained impregnated ovum, must remain unanswered. Many claim that the seat of coalescence of the male and the

female elements is normally in the Fallopian tube. If this claim be admitted, it can readily be seen how a variety of causes might operate to detain the ovum in the tube, where it may continue to develop extra-uterine. Chief among the causes ascribed a few years ago, at the revival of this subject, was the loss of the tubal ciliated epithelium, which would manifestly conspire to prevent the ovum from being carried on down into the uterus; other causes cited have been flexions of the tube, dilatations and diverticula, constrictions from inflammatory changes, and polypi in the tube, closing its lumen like a valve.

While a variety of causes may operate, it is most probable, from the frequency with which old inflammatory disease is found coexisting on the other side, that most cases of tubal gestation arise from ileus of the tube, resulting in an inability to transmit the contents of the tube, due to adhesions. An important cause, operating in cases where the pregnancy is toward the outer end of the tube, is the presence of a diverticulum, as pointed out by J. W. Williams.

Classification: Primary Forms.—The primary forms of extra-uterine pregnancy are classified as follows:

- | | | | | |
|-----------|---|-------------------------------|--|-------------|
| 1. Tubal: | { | Tubo-uterine or interstitial. | | 2. Ovarian. |
| | { | Isthmial. | | |
| | { | Ampullar. | | |

Secondary forms are derived from the primary, as follows:

- | | | | | | |
|----------------------------|---|-----------------|------------------------|---|-----------------|
| (a) From the interstitial: | { | Uterine; | (c) From the ampullar: | { | Tubo-ovarian; |
| | { | Broad ligament; | | { | Abdominal; |
| | { | Abdominal. | | { | Broad ligament. |
| (b) From the isthmial: | { | Abdominal; | (d) From the ovarian: | { | Abdominal; |
| | { | Broad ligament. | | { | Tubo-ovarian. |

In tubal pregnancy, when the fertilized ovum develops out near the fimbriated extremity of the tube it is called *ampullar*; at the inner portion of the tube it is called *isthmial*; while in that part of the tube which traverses the uterine wall it is designated *interstitial* or *tubo-uterine*. It is in the latter form that the term *extra-uterine* pregnancy becomes a misnomer, as the conception is not, strictly speaking, extra-uterine, being enclosed in the wall of the uterus, although outside its cavity. For this reason Mr. Tait suggested the term *ectopic* gestation. Many writers, more practical than scientific, were misled by Mr. Tait's dicta to go so far as to hold that there is but one form of ectopic gestation—namely, the tubal—and so able a pathologist as Bland Sutton gives them countenance by his denial of the ovarian and abdominal forms, as he considers the cases which have been reported do not sufficiently demonstrate their existence. No criticism, however, has yet succeeded in destroying the claims of cases of Leopold, Patenko, and Martin, which we must accept as primarily ovarian. In Leopold's case the patient was operated upon for a pelvic tumor of twenty-five years' standing that proved to be an ovarian tumor containing a lithopedion. In the walls of the tumor ovarian stroma was clearly demonstrated. Patenko's case is even more striking. The right ovary was the size of a hen's egg, and it contained a cyst with smooth walls in which was found a yellow body, the size of a hazel-nut, composed of

cylindrical and flat bones. These bones, which were submitted to a careful microscopical examination, were found to be fetal in origin and not the product of a dermoid cyst. The enveloping wall contained corpora lutea and follicles. The tube of the affected side had no adventitious connection with the ovary, and its fimbriated extremity was entirely free, although the internal ostium was closed and some of the fimbriae were gone. Opponents of the theory of ovarian pregnancy take exception to this case, claiming that the gestation was primarily tubal, and that a so-called "tubal abortion" had occurred into the ovary, and that later the ovary and the tube had become detached from each other!

Martin of Berlin reports two cases which he believes to be examples of undoubted primary ovarian pregnancy. In these cases the gestation-sac was



FIG. 154.—Prof. August Martin's case of ovarian pregnancy. The intact tube is seen lying above the ovarian sac containing the fetal envelopes.

situated entirely within the ovary, the fimbriated extremity of the tube being intact. As an explanation of ovarian pregnancy Martin advances the very natural suggestion that the spermatozoön finds its way through the fimbriated extremity of the tube into one of the small recently-ruptured cysts so frequently found on the surface of the ovary, and that it there coalesces with the ovum.

Too few observations have yet been made to prove the possibility of primary abdominal pregnancy, although the case of Schlectendahl is difficult to explain upon any other hypothesis. In this case a fetus measuring 15 centimeters (6 inches) in length was found attached to the abdominal wall near the spleen in a woman who had died of hemorrhage. The gestation-sac was surrounded by adherent intestines, and the uterus and appendages appeared normal. For the present, however, only two primary forms of ectopic gestation—tubal and ovarian—can positively be accepted. Practically, tubal pregnancy is the only primary form found.

Secondary Forms.—The secondary forms of ectopic pregnancy are derived from the primary. The tubo-uterine or interstitial pregnancy may rupture into the uterus and be followed immediately by expulsion of the fetus, or it may go on to full term and be delivered in the natural way. This mode of termination, unfortunately, is rarer than two other possibilities—namely, rupture into the abdominal cavity or rupture into the broad ligament. In the isthmic form of tubal pregnancy the rupture occurs either into the abdominal cavity, thus forming a secondary abdominal pregnancy, or into the broad ligament, forming extra-peritoneal, broad-ligament pregnancy. The ampullar form of tubal pregnancy gives rise to secondary tubo-ovarian, abdominal, or broad-ligament pregnancy.

Tubal Pregnancy.—In the first week after fecundation of the ovum the tube begins to thicken, due chiefly to vascularization without hypertrophy of the muscular fibres. In this respect the tubal envelope differs in its development from that of the uterine muscle in normal pregnancy. In the latter case there is hypertrophy of the individual muscle-fibres to eleven times their length in a normal non-pregnant uterus; the connective tissue, peritoneal covering, blood-vessels, and lymphatics being also increased by hypertrophy and hyperplasia, so that at full term the uterus weighs two pounds instead of two ounces, the weight of a virginal uterus. The thickening in the pregnant Fallopian tube is due to excessive vascularization with but slight increase in the tissue-elements. As the pregnancy progresses the wall of the tube becomes thinned and stretched until in some cases it appears as a thin transparent membrane composed only of an attenuated stratum of muscle covered with peritoneum.

The development of the fetal membranes derived from the ovum, with the exception of the placenta, is the same as in intra-uterine pregnancy. Normally, the placenta is derived about equally from the decidua serotina of the uterus and the chorion frondosum of the ovum. In tubal pregnancy Bland Sutton holds that the placenta is largely fetal in its origin. As the embryo increases in size and the walls of the tube become stretched, the plicæ in the mucous membrane lose their characteristic appearance and are gradually smoothed out. During the first four to six weeks the abdominal ostium of the tube becomes hermetically sealed. Until the fetal membranes are well formed the life of the fetus is in constant jeopardy, as the chorionic villi have but a feeble hold upon their points of attachment to the tube and may easily be dislodged. This termination is most favorable from the first to the third week of the pregnancy, and it may be so harmless as to give rise to no serious discomfort.

An apoplectic ovum thus detached appears as a lump of coagulum, and unless carefully examined its true character may be overlooked. Such bodies, known as "tubal moles," are absolute proof of the nature of the pathological condition. As the pregnancy advances the formation of the tubal mole is attended with much greater danger, as the accompanying hemorrhage often causes rupture of the tube, followed by rapid death of the mother. These moles, if recent in origin, will be found to contain the embryo and its mem-

branes. The absolute diagnostic point is the discovery of chorionic villi or of the embryo itself. If extruded into the abdominal cavity or into the broad ligament the mole loses its characteristic appearance and soon becomes enveloped in a yellowish coat of fibrin, and there may be such complete disintegration of the fetal tissues as entirely to obliterate its embryonic characteristics. The villi, however, are most persistent, and they may be found after the other evidences of their origin have disappeared. These villi have the same appearance under the microscope as those of normal pregnancy.

If the ovum continues to grow, the point at which the placenta is attached is of the greatest importance to the mother, as upon this largely depends her chance for life in case of rupture. If the placenta is implanted on the superior wall of the tube, the mother is in constant peril, as rupture here may be followed by frightful hemorrhage, the lacerated or detached placenta having no counter-pressure to control its bleeding, as is the case when it is attached to the floor of the tube. For this reason many surgeons claim that this termination is invariably fatal. If the placenta is implanted on the floor of the tube, the chances of rupture are not necessarily decreased, but the dangers attending this accident are far less to the mother. In this position the placenta is pushed downward against the resisting pelvic floor, insinuating itself between the layers of the broad ligament. If the embryo is extruded through the upper wall of the tube, the placenta may still retain a firm attachment and only slight hemorrhage follow, and the immediate danger be escaped in this way. Occasionally the ovum is lightly attached in the ampullar extremity of the tube, and is extruded into the abdominal cavity without rupture of the tubal walls. This extrusion is known as "tubal abortion." As evidence of this the fimbriated extremity of the tube is found enlarged and patulous, and there is free blood in the abdominal cavity, in which the tubal mole may be found if the abortion is recent.

Tubo-uterine or Interstitial Gestation.—The history of the embryonic development in this type of ectopic gestation differs from the tubal proper on account of its difference in environment. Here the muscular fibres of the uterus undergo the same changes as in normal pregnancy. Rupture is almost inevitable, but it does not occur so early as in the tubal variety, on account of the greater thickness of the walls surrounding the gestation-sac. Hecker collected twenty-six cases in which rupture occurred before the sixth month. The fetus occasionally escapes into the uterus, and it is either expelled at once or it goes on to regular term and is born in the natural way. Rupture occurs most frequently into the abdominal cavity, and in such cases the hemorrhage is profuse and usually terminates the patient's life in a short time. Interstitial pregnancy is rarely recognized before rupture.

Rupture of the Sac.—The time of rupture of the sac depends upon its location and, to a certain extent, upon the attachment of the placenta. In tubal pregnancy primary rupture occurs usually between the second and the fourteenth week. When the placenta is implanted on the floor of the tube, the probability is that the rupture will not take place so early as when it is situated

on the superior wall. The causes of rupture are thinning of the walls of the tubes beyond the limits of elasticity, hemorrhage into the sac, traumatism, and gradual enlargement of the embryo. If the patient survive the primary rupture, the fetus may still continue



FIG. 155.—Diagram showing pelvic hematocoele posterior to the uterus, which is crowded forward with the bladder behind the symphysis pubis, while the rectum is compressed behind against the sacrum (Skene).

to develop, either burrowing downward between the layers of the broad ligament or growing upward into the peritoneal cavity among the intestines. The injury to the placenta is much less when it is situated on the pelvic floor, as the displacement is not so marked, the hemorrhage is not so profuse, and consequently the lives of the fetus and the mother are in less jeopardy at the time of rupture. If blood is poured into the peritoneal cavity, it will usually be absorbed; if the collection of blood occurs between the layers of the broad ligament, it constitutes pelvic hematocoele (Fig. 155). When the fetus

becomes intra-ligamentary and continues its development in that position, it is known as *broad-ligament gestation*. After the twelfth week the sac is liable



FIG. 156.—Ruptured left tubal pregnancy, fetus still attached and lying within the pelvis. Hydrosalpinx and adhesions on the right side. Uterus displaced toward the right by the sac: *u* is the fundus uteri; *r*, the rectum; *t*, the right closed tube; *f*, the fetus; and *s*, the ruptured extra-uterine sac.

to secondary rupture at any time up to term. Here again the situation of the placenta is of the same importance in the prognosis as in the primary rupture.

The Fetus.—The question as to the possibility of life for the fetus is influenced by the location of the pregnancy. In the tubal variety the most favor-

able attachment of the placenta is on the floor of the Fallopian tube, as there may be slight if any disturbance of the fetal circulation if the rupture be in the superior wall of the tube, when the child may go on to full term (Figs. 156, 157). Even, however, if the ectopic fetus be delivered alive, it is often deformed and puny and rarely lives more than a few days. For this reason its life should be but little regarded in the treatment of ectopic gestation.

The disposal which nature makes of the fetus in case the mother survives the rupture is also of considerable interest. The dead embryo lying free in the abdominal cavity may be completely absorbed up to the second month; after that period it either undergoes mummification, calcification, or is converted into adipocere, or decomposes. Mummification is analogous to the change which bodies undergo in a dry atmosphere. A mummified fetus in its general appearance closely resembles bodies found in arid regions buried in

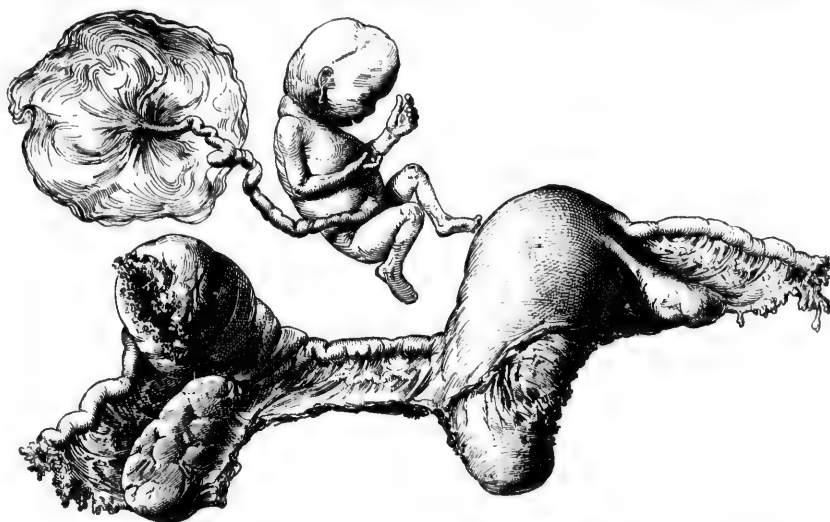


FIG. 157.—Cornual pregnancy. In this case rupture occurred in the right undeveloped cornu of a bicornute uterus (from a specimen presented to the writer by Dr. Watson of Baltimore).

dry soil or in sand or exposed to the air. The fluid constituents of the extra-uterine gestation are absorbed, and the soft tissues become leathery or parchment like. In other cases the fatty elements are converted into adipocere or into ammoniacal soap in the presence of ammonia formed by the decomposition of the tissues. Either the mummified or the adipocere fetus may still undergo further change and become partially or wholly calcified. This process is not entirely confined to the superficial parts, as there have been described a number of specimens which exhibited the saponaceous or the mummification process on the exterior while the internal organs were calcified. A fetus which has undergone calcification is known as a *lithopedion*.

The fetal mass may remain indefinitely in the abdominal cavity without giving rise to any discomfort to the mother. Cases are reported in which

such bodies have stayed for ten and fifteen years, in one instance for fifty-four years, in the pelvis without giving rise to serious trouble. On account of the close anatomical relation between the gestation-sac and the rectum and intestines a slight rupture of the intervening walls may occur at any time, or a diapedesis may take place and pyogenic organisms gain access into the sac and induce suppuration. The fetus is then converted into a putrid mass, which may be discharged into the rectum, the vagina, or the bladder. Occasionally the suppurating mass ruptures at some point on the anterior abdominal wall even so high as the umbilicus. The latter termination is frequently noted in the older medical literature.

Symptoms.—All the symptoms characteristic of normal pregnancy may be present. Frequently, however, the subjective symptoms are entirely absent, and the patient may be quite unconscious of her condition. The increase in the areolar circle around the nipple and other mammary changes, the gastric disturbance, pain on the affected side, associated with amenorrhea, are the most characteristic symptoms. Too much stress, however, must not be laid upon the absence of the menstrual flow, as it is subject to the greatest variations. In some cases instead of amenorrhea there will be profuse metrostaxis with the expulsion of small bits of decidua.

It is of importance not to confuse the decidua of ectopic pregnancy with that of membranous dysmenorrhea. In the latter condition the decidua is usually expelled in small pieces and rarely as a cast of the interior of the uterus. When floated out in water numerous delicate velamentous processes are seen. This membrane is rarely more than one or two lines in thickness, and it is usually very friable. The decidua of ectopic pregnancy is much thicker, varying from 5 to 20 millimeters ($\frac{3}{16}$ to $\frac{1}{2}$ inch); it is much less friable, the uterine surface being covered with a thick, shaggy, villous coat, and instead of small bits it is usually expelled in large pieces or as a complete cast of the interior of the uterus. Pain is variable, in some cases being almost constant, in other cases absent. The character of the pain before rupture may be sharp and lancinating, or there may be dull and heavy aching. The statement of the patient that she considers herself pregnant is of some value, as that ill-defined sense upon which she bases her opinion may be the only subjective indication of her condition. The appearance of the external genitalia may be the same as in normal pregnancy. Under these circumstances the vaginal mucous membrane appears purplish in hue, the cervix is soft, the os uteri is usually closed with a plug of mucus, and the uterus, instead of its pyriform shape, is now globular and enlarged to the size of a one-month pregnancy.

If an examination be made before rupture, the Fallopian tube of one side will be found enlarged, and if far advanced the uterus will be forced from its position in the median line by the growth of the tumor. If the pregnancy is advanced to the third or the fourth month, a circumscribed tumor, well defined as an area of dulness on the anterior abdominal wall, may be outlined by percussion. Vaginal examination reveals this tumor lateral

and posterior to the uterus, with a well-marked sulcus between it and the uterus. Unfortunately, it is only in the rarer instances that a physician is called before rupture occurs, when, unless he is a skilful specialist, the probabilities are that ectopic gestation will not be suspected. The growth of the tumor may give rise to pressure-symptoms, such as constipation and dysuria, but they are of little special significance, as any pelvic tumor may be attended with similar disturbances.

Rupture.—The symptoms of rupture are very characteristic, and they usually are so definite as to cause little doubt in diagnosis. A patient previously healthy or only slightly complaining is suddenly seized with severe abdominal pains, sharp or lancinating, cutting or agonizing. The attack in many instances cannot be ascribed to external violence or to undue exertion on the part of the patient, as she may be in the midst of light household work, or walking on the street, or even be in bed when the rupture occurs. Previous to the attack she may have had no discomfort or only the slight disturbances of pregnancy. If the hemorrhage is extensive she may fall unconscious as if struck a blow. The pulse, at first rapid, soon becomes almost or quite imperceptible; the respiration is quickened, then becomes jerky, and finally the air-hunger so characteristic of severe hemorrhage becomes pronounced; vertigo, nausea, and vomiting are present. The symptoms soon merge into those of profound shock, the extremities being cold and clammy, the skin pale, the conjunctivæ pearly, and the lines about the mouth drawn. If the patient is conscious and is able to talk, she will usually complain of intense abdominal pain. Death may follow soon after intraperitoneal rupture, or it may be delayed for a day or even longer. In some instances the bleeding ceases for a short time and is followed by gradual improvement in symptoms, but it again begins a few hours or some days later, and the patient survives only a few minutes.

In extraperitoneal hemorrhage from rupture into the broad ligament the symptoms may not be so urgent. The initial attack in both instances is similar, as the peculiar sharp pain at the onset is due to rupture of the tube. The blood as it accumulates usually checks the hemorrhage by its own pressure, and the patient may have no further trouble. If the embryo dies at the time of primary rupture into the broad ligament, no further discomfort is felt, as a rule, as a harmless hematocele is all that remains. Unfortunately, in many instances this is not the termination, and the fetus continues to develop, and sooner or later a secondary rupture occurs, attended by the same symptoms as the primary rupture.

In the rarer cases, which go on for nine months, labor-like pains come on and closely simulate those of normal parturition. These pains may continue for hours or even for days, and then cease. The escape of blood and of portions of the decidua occurs in a majority of cases at this time, and may mislead the attending physician into the diagnosis of abortion if the constitutional symptoms are not urgent. The subjective symptoms of pregnancy are almost always present in such advanced cases. The fetal movements may have been

so much on one side as to call the mother's attention to this phenomenon. The fetal heart-sounds are distinct, being heard with unusual clearness.

In cases surviving the rupture the sharp labor-like pains gradually subside, the secretion in the breasts disappears, the tumor decreases rapidly in size, and as soon as the patient recovers from the shock and loss of blood she may regain her health. It is in these cases that absorption or one of the other changes that render the fetal body innocuous takes place. Infection of the incarcerated fetal mass may occur at any time, even years after the death of the embryo, followed by a train of symptoms similar to those attending pus-formation from other causes.

Diagnosis.—The history, if carefully reviewed, often directs attention strongly toward ectopic gestation. The pregnancy usually occurs in a multipara some years after the birth of the last child, although it may follow shortly. There may have been an intervening attack of acute inflammation of the tube or of pelvic peritonitis. This is strongly insisted upon by those who advocate the theory that tubal gestation is due to an old inflammatory process which has changed the normal histology of the tube.

A characteristic history is as follows: A woman who has borne one or more children, after an interval of from five to twenty years of sterility observes symptoms of another pregnancy. Her menses, which have been regular, cease, and the morning nausea, pain in the breasts, darkening of the areola, and other symptoms characteristic of her former pregnancies appear. In addition to these symptoms, she has in one ovarian region dull pain, at times so severe as to cause her to seek the advice of her physician. This pain may continue until it culminates in the acute paroxysms caused by rupture, or it may cease, and not be noticed again until the rupture occurs. The most characteristic symptom of all is the sudden sharp pain of the rupture. If followed by a marked anemia it is still more decisive. The bimanual examination, taken in conjunction with this history, points with absolute certainty to the nature of the pregnancy, and the diagnosis is comparatively simple. In the atypical cases, on the contrary, a positive diagnosis is often difficult or even impossible.

In the normal uterine pregnancy, as the embryo develops the uterus is distended equally in all directions, but occasionally the ovum develops in one corner, distending the uterus on that side, which may prove misleading. In pregnancy occurring in the rudimentary horn of a bicornute uterus the symptoms are so nearly alike that a differential diagnosis is not likely to be made.

Kussmaul collected thirteen cases of pregnancy in rudimentary cornua, the majority of which had been reported as tubal pregnancies. If an exploratory section be performed in these doubtful cases, the anatomical points insisted upon by Mauriceau are of the greatest value in making a differential diagnosis. They are as follows: In cornual pregnancy the round ligament is situated anterior to the outer side of the gestation-sac. In tubal pregnancy the round ligament is situated on the uterine side (Figs. 157, 158).

Pregnancy occurring in one horn of a well-developed bicornute uterus may

go to term and give rise to no untoward symptoms. A pregnant uterus deviated to one side by a myoma may be mistaken for ectopic gestation. The diagnosis, however, can usually be made if the examination is conducted under anesthesia, as it will be found that the tumor varies its position with that of the enlarged uterus, and is directly continuous with it, in addition to being densely hard. The question of interstitial pregnancy naturally arises in these cases, and if the character of the tumor cannot be recognized at the first examination, the patient's symptoms should be observed carefully, and she should be examined again later to decide whether there is any increase in the size of the suspected tumor. If there is a perceptible increase, the probabilities are that it is interstitial pregnancy. An adherent retroverted gravid uterus may also give rise to misleading symptoms, such as sharp pains, obstinate constipation,



FIG. 158.—Diagrammatic sketch showing relations of an unruptured sac (*s*) to uterus (*u*), round ligament (*rl*), and bladder (*b*). The numerous adhesions are suggestive as to the etiology.

pelvic pressure, dysuria, etc., but it is readily differentiated by a bimanual rectal examination, if necessary drawing the uterus down with traction forceps so that the fundus may readily be palpated.

Ovarian tumors and enlargements of the Fallopian tubes, associated with intra-uterine pregnancy, may cause confusion, especially if the tumor lateral to the uterus gives rise to sharp pain, as may occur in pyosalpinx. In such instances the question of a twin pregnancy, one intra-uterine and the other extra-uterine, must be considered. As fever accompanies pyosalpinx in the majority of cases, it must carefully be considered in the differential diagnosis. If it be impossible to arrive at definite conclusions concerning the suspected mass, and the life of the patient seems in peril, an exploratory celiotomy is justifiable, otherwise expectancy is the safer course. Occasionally a pedunculated ovarian cyst becomes strangulated by axial rotation: such an accident is accompanied by pain, vomiting, rapid pulse, and other constitutional disturbance, at times amounting to profound shock. Rupture of an ovarian cyst may also be difficult to differentiate from the rupture

of an ectopic gestation sac; in such cases the history and the vaginal examination will clear up the diagnosis.

To summarize briefly, it may be said that the diagnosis of ectopic gestation depends upon the following cardinal points:

1. A history of probable pregnancy.
2. Paroxysmal pains, usually located on one or the other side of the pelvis.
3. Irregular metrostaxis.
4. The expulsion of bits of decidua.
5. Coincident enlargement of the uterus and softening of the cervix and discoloration of the vagina.
6. Tumor lateral or posterior to uterus and indirectly connected with it, uterus moderately or not at all enlarged.
7. Changes in the breast.
8. Anemia.

The diagnosis of ectopic gestation after the death of the fetus is largely dependent upon the clinical history; if this be deficient, the diagnosis is frequently impossible, especially if there has been a long interval between the rupture and the time when the patient consults the physician. If the fetus has undergone calcification, it may be felt as a hard mass, but even this is not conclusive, as a calcified myoma may present similar characteristics.

Treatment.—From the operative standpoint it is best to divide ectopic pregnancy into the following periods:

1. Before rupture; 2, at the time of rupture; 3, after rupture; and 4, after calcification, saponification, mummification, or suppuration of the fetus has occurred.

1. *Before Rupture.*—The electrical treatment, so much advocated a few years since for the destruction of the fetus, while valuable in its day as pioneer work, has deservedly fallen into disrepute, because of its uncertainty in terminating the fetal life and of its dangers to the mother through subsequent inflammation. The injections of fluids into the sac for the same purpose is so utterly foreign to present ideas of treatment that it is only mentioned to be condemned. The proper course to pursue is the removal of the affected tube. Precipitate operation, however, is not advisable, as the diagnosis should be as accurate as possible before resorting to radical measures. Cases with a history suggestive of ectopic gestation and a mass lateral to the uterus detected by vaginal examination should be operated upon without hesitation. A proportion of such cases will prove to be pyosalpinx or hydrosalpinx, but an error is not serious, as in either instance operation is indicated.

2. *At the Time of Rupture.*—If called at the time of rupture, the surgeon must exercise considerable judgment in his decision whether or not to operate immediately. If the patient is in collapse, the pulse weak and rapid, and the skin blanched and clammy, an immediate examination should be made to discover if possible whether rupture has occurred into the broad ligament or is intraperitoneal. If the rupture has taken place into the broad ligament, a lateral tumor-mass closely connected with the uterus will be

detected. The mass is circumscribed and fluctuating, and rectal examination shows the cul-de-sac to be free of fluid. In such a case the method of treatment is an expectant one, the possibilities being that the hemorrhage will soon cease if it has not already done so, and that the patient will recover, leaving

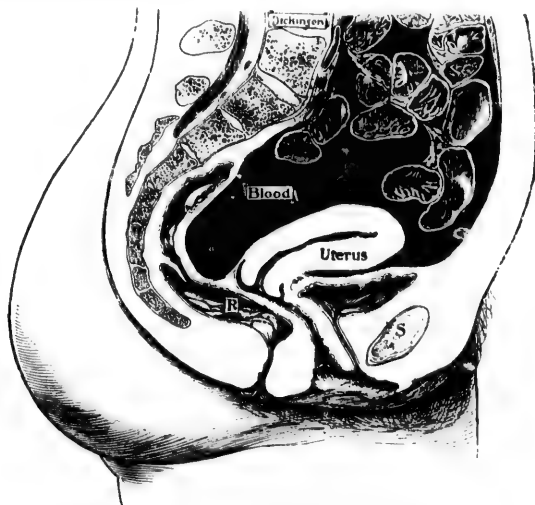


FIG. 159.—Diagram of intraperitoneal rupture of tubal pregnancy. Free blood in Douglas's cul-de-sac and among the intestines (Dickinson): S, symphysis; R, rectum.

a hematocele to be dealt with later if necessary. If examination reveals free fluid in the cul-de-sac (Fig. 159), and there are no signs of improvement in the patient's condition, the natural inference is that the rupture is intraperitoneal, and an immediate operation is indicated, as every moment detracts from the chances of recovery (Fig. 160).

Preparation for Operation.—The chances for recovery following operation in extra-uterine pregnancy depend upon the careful observation of all the details of antiseptic and aseptic technique. For this reason a precipitate operation is always attended with

greater danger, as of necessity care in details must be sacrificed. The surgeon should always have a complete set of abdominal instruments and accessories sterilized and packed ready for use. If the operation is hurried, select a well-

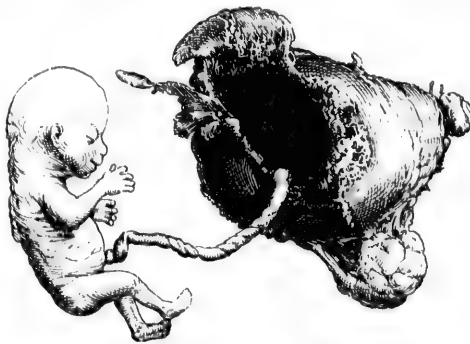


FIG. 160.—Dr. Peek's case (Youngstown, Ohio) of extra-uterine pregnancy in the third month; operation at time of rupture; recovery.

lighted room or provide a portable electric light; remove all unnecessary furniture, dampen the floor to prevent dust rising, but do not disturb the curtains and other hangings further than is absolutely necessary. A common kitchen table can be turned into an operating-table, with a chair inclined against one end, upon which the patient's feet may rest. Cover the table with a folded blanket, lay upon this a Kelly ovariectomy pad, and place a small pillow at the head.

As it may be necessary to irrigate, a douche-bag should be suspended in a convenient position near to, and about 4 feet above the level of, the table. Two smaller tables are required for the instruments and dressings, and three or four chairs for the wash-basins and sponge-dishes. A room thus hastily improvised serves admirably for an operating-room.

An abundance of boiled water is necessary. Directions should be given immediately after deciding to operate concerning the preparation of the water. A wash-boiler or other large tin vessel must be scalded thoroughly, and be partially filled with water which is allowed to boil for an hour if possible. It is best to let the water cool to 110° F., but if time is pressing pure cold water from a well or a hydrant may be used for reducing it to proper temperature. This method of cooling the water, however, is not advisable except under stringent necessity.

Great care must be observed by the physician in disinfecting his hands: they should be scrubbed thoroughly with a nail-brush with soap and water, followed in succession by immersion in permanganate of potassium (hot sat. sol.) and oxalic acid (hot sat. sol.). A quart of each of these solutions is sufficient. The patient, under anesthesia, is then transferred to the operating-table and is rapidly prepared for abdominal section. The anterior and lateral surfaces of the abdomen are thoroughly washed with soap and water, followed by alcohol, then by ether, and finally by bichlorid solution (1 : 1000). As it may be necessary to open the sac through the vagina, this passage should be washed thoroughly with soap and water, followed by bichlorid solution (1 : 1000) and an iodoform pack. All dressings, towels, and gauze to be used in immediate proximity to the field of operation must be provided by the surgeon, who should always carry them among his accessories, as the sterilization of these articles cannot be entrusted to an untrained person. Instruments are taken from their sterilized envelope and placed on towels or in trays.

During the preparation the patient should be given a stimulating enema, also strychnia (gr. $\frac{1}{40}$) and brandy hypodermatically. In such cases as these the infusion of normal salt-solution into the radial artery is often of the greatest service in sustaining the patient's vital forces, and occasionally it is absolutely necessary to save life. It is unnecessary to carry a special infusion apparatus, as an ordinary aspirator admirably serves the purpose. To prepare normal salt-solution dissolve 6 grains of sodium chlorid in one liter (a quart) of boiling water and boil for some minutes. Select one of the smaller blunt-pointed aspirator needles. Fill the aspirating bottle three-fourths full of the solution, cork tightly, and, instead of making a vacuum in the bottle, force in air

until the pump works with difficulty, then turn the entrance stopcock. The radial artery is the most accessible for infusion, as it can be utilized if necessary for this purpose by an assistant while the abdominal operation is in progress. Cut down somewhat obliquely on the artery, and place a provisional ligature above and below the point of infusion. When ready to introduce the fluid invert the bottle, turn the exit stopcock, and insert the needle into the artery while the fluid is flowing, thus preventing the possibility of introducing air. The dangers of this accident, however, are practically of no moment if the fluid is injected centrally into the artery.

If the exsanguination is extreme, a liter (a quart) of solution at a temperature of 105° F. may be infused. After the needle is withdrawn both ligatures are tied and the wound is closed with a subcutaneous stitch. It is remarkable how quickly the pulse improves under this infusion: it may grow weaker shortly after, but if the bleeding is completely checked the chances for recovery are far greater if infusion is employed. The fluid used must be perfectly free from dirt or bits of cotton, etc., which produce emboli and cause gangrene.

The Operation.—The abdomen should be opened freely in the median line; the clots should be turned out, exposing the ovarian and uterine arteries, which are caught either with forceps or between the fingers. If on attempting to clear the pelvis of clots fresh blood wells up, no further time should be lost in attempts to expose the bleeding points, but the operator must introduce his hand into the pelvis, grasp the arteries, and then apply hemostatic forceps. Having controlled the active hemorrhage, he can then carefully cleanse the abdomen of clots, inspecting closely the débris as he does so for the embryo or the tubal mole. If the pregnancy is in the first or second month, the operation consists of a simple salpingo-oöphorectomy; if, however, the term is farther advanced and the placenta is extensively attached to the interior of the tube, or in case of previous rupture to the intestines and pelvic walls, the operation is not so simple, and calls for good judgment to know how best to deal with the placenta. It is exceedingly hazardous to attempt the removal of a placenta which is firmly attached, as the hemorrhage following its dislodgement may be so extensive as to defy control. In such cases it is best to leave the placenta *in situ*, for to attempt its removal would take away any chance the patient has for life in her condition of shock and exsanguination.

No means further than those necessary to save life at the time of operation should be undertaken, as the essential principle is first to control hemorrhage, leaving subsidiary conditions for subsequent consideration. If the placenta be attached exclusively to the floor of the tube or the pelvis, its blood-supply may be derived from numerous vessels, and an attempt to control these by ligation would be impossible. The best course to pursue in such cases is to check the hemorrhage, tie and cut the cord close to its placental origin, and leave the placenta undisturbed. Drainage should not be employed in these cases, because of the increased danger of sepsis. The proper treatment is to close the abdomen completely, and after the patient has recovered a second

operation may be performed for the removal of the placenta if it cause untoward symptoms. The greatest care in aseptic and antiseptic details should be observed, as upon the absence of infection depends the patient's chance for recovery when the placenta is not removed. If the operation is absolutely aseptic, the prognosis is good, as the placenta atrophies and gives no further trouble. If, however, the case is infected, suppuration of the placental mass occurs, terminating in general peritonitis or in a pelvic abscess. Often in the course of an operation the placenta becomes detached and may be removed with the fetus. In all cases in which the operation follows the death of the fetus by some days or weeks the placenta is only held by the slightest attachment or it may lie free in the gestation-sac. It is for this reason that the operation is more favorable at such a time, as the dangers of hemorrhage are much decreased.

In some cases, especially those in which there is a temporary cessation of the bleeding, the slightest disturbance of the sac after the abdominal cavity is opened causes a renewal of the hemorrhage. Bold surgical measures are then demanded: the operator should sweep his hand rapidly around the ectopic sac, loosening the adhesions, after which the sac is delivered from its bed of adhesions. The points of bleeding can then be reached and controlled. Adhesions to the omentum should be tied off in small sections to prevent necrosis *en masse*.

If the intestines crowd down into the field of operation, and if the operator is unable to pack them back satisfactorily with sponges, the patient should be placed in the Trendelenburg position. In case there is extensive oozing on the floor of the pelvis after the removal of the placenta, that it is difficult or impossible to control by ligatures, a strip of iodoform gauze should be packed down upon the bleeding points. If there is a large amount of debris scattered throughout the abdominal cavity, free irrigation with sterilized normal salt-solution (6 per cent.) at a temperature of 110° F. should be employed; 3 or 4 liters (3 or 4 quarts) of the solution may be necessary to cleanse the cavity. There is no danger from the distribution of this material in the abdomen by irrigation, as the ectopic product is sterile except in the rarest cases.

In all ectopic cases that undergo operation the opposite tube and ovary should closely be examined, and if normal or if only slightly adherent they should not be removed; otherwise their extirpation is demanded, for to allow a diseased tube and ovary to remain, which can be of little if any further functional value, would only subject the patient to the dangers of a subsequent ectopic pregnancy or to the discomfort and pain due to adherent appendages.

3. *After Rupture.*—Contrary to the natural inference, cases are not usually submitted to operation at the time of rupture, as by the time the surgeon is called the patient is either recovering or is dead from extensive hemorrhage. In a certain proportion of cases the patient, although feeling the sharp pain accompanying the rupture and being compelled to keep to her bed for a day or so on account of weakness, does not call her physician, as she considers it

only a trifling matter associated with her pregnancy. There is undoubtedly a considerable number of cases like the latter in which the death of the fetus occurs at the time of rupture and no further symptoms are observed, and the patient makes a perfect recovery. It is for this reason that a statistical table compiled for the purpose of ascertaining the rate of mortality in extra-uterine pregnancies due to rupture is fallacious. If the surgeon sees the patient immediately after rupture, and there is a general tendency to improvement in all her symptoms, he should defer operating until a future date, to be determined by the patient's condition.

If the rupture be extraperitoneal in a case in which the pregnancy has advanced only to the first or second month, an operation should not be performed unless the fetus continues to develop in its new location or untoward symptoms arise from the hematocele. To subject a woman to an operation for a hematocele which is giving her no trouble is, to say the least, bad judgment. If the life of the fetus is not destroyed at the time of rupture, the operation should be performed as soon as the patient has recovered from the primary rupture. The life of the fetus must not influence the determination to operate, and under no circumstances should operation be delayed on account of sentiment in its behalf.

As the dangers of operation greatly increase as the pregnancy advances toward term, on account of the development of the placenta increasing the dangers of hemorrhage, the earliest date possible should be selected for operation. A free incision should be made in the central line of the abdomen. If the pregnancy is in the early weeks, the operation may be no more difficult than a salpingo-oophorectomy for pyosalpinx or for hydrosalpinx. The danger of hemorrhage, however, from the broad ligament is somewhat greater than in the ordinary salpingo-oophorectomy, on account of the increased vascularity of the tube, and great care should be exercised in placing the ligatures so that they will control all blood-vessels. The transfixion needle should not be employed for this purpose, as the subsequent shrinkage of tissue following the removal of the vascular tube is liable to dislodge the ligature, as more tissue is usually included, and a larger size of silk is employed, than when the ligament is tied off in small sections. The pregnant tube when the ligatures are laid should be lifted well out of its bed with a medium-sized curved needle armed with a carrier. The medium-sized silk suture is the best in this location, as it stands sufficient strain easily to control hemorrhage, and yet does not strangulate the tissues *en masse*. Each suture should overlap, in an imbricated manner, the one placed immediately before it; thus no vessels can possibly escape ligation.

If pregnancy is further advanced and adhesions have formed between the gestation-sac and the adjacent viscera or the pelvic floor, or if it is a broad-ligament gestation with the placenta firmly implanted on the pelvic floor, the operation becomes one of the most difficult in abdominal surgery. The adhesions should be dissected off carefully, all bleeding points should promptly be ligated, and the sac should be enucleated in the ordinary manner. Drainage

should not be used if it can possibly be avoided; only persistent oozing which cannot be controlled by ligatures justifies its employment, as the dangers of infection are greatly increased by leaving the abdominal cavity open.

The fact that particles of clots and other débris are scattered throughout the abdominal cavity does not indicate drainage, as such material is innocuous if the field has been kept aseptic, and it will give no trouble if the wound is hermetically sealed. It is in these densely-adherent or broad-ligament cases that enucleation of the sac is often impossible, and that other measures must be resorted to for the relief of the patient. The treatment of the ectopic sac then becomes a question of great importance, as the adhesions to neighboring viscera or to the pelvic floor may be so extensive as to preclude its removal, as the danger of hemorrhage following its enucleation is too great in such cases. This question should usually be decided after the abdomen is opened. The extent of adhesions and the vascularity of the sac and adjacent tissue should be noted carefully, and if of such a degree as to contra-indicate removal, the next measure, that of making an extraperitoneal opening, must be resorted to.

Extraperitoneal Evacuation of Gestation-sac.—The point of opening depends entirely upon the location of the sac: if it is situated low in the pelvis and is of easy access through the vagina, unquestionably the best method of procedure is to evacuate the contents of the sac into that canal and establish free drainage. The best method of opening the sac is as follows: After carefully examining the pelvic mass and deciding where the accessible point for opening is—usually in the fornix—the operator thrusts a pair of medium-sized sharp scissors, guided by the index finger of the vaginal hand, into the sac, and withdraws them partially open; this is followed by larger scissors, which are also withdrawn in the same manner. While doing this it is usually best for the operator to have his assistant press the sac gently downward through the abdominal incision. After evacuating the embryonic débris with the fingers or with placental forceps, the sac should be irrigated freely with sterilized water or with a very weak bichlorid solution (1:20,000), followed by warm water. After cleansing the sac thoroughly it can be packed with iodoform gauze, care being taken to leave a free opening for subsequent discharge.

The greatest care must be observed in passing from the abdominal to the vaginal operation, as to make a vaginal examination followed by the manipulation necessary to evacuate the sac by the vagina, and then to close the abdomen without the most careful disinfection of the hands, would be an unpardonable mistake. It is usually best for the operator to entrust the closure of the abdomen to his assistant. If the sac, instead of being in close relation with the vaginal fornix, is found to be pushed up above the uterus, and is situated nearer the anterior abdominal wall, the vaginal method of treatment is not advisable, as there may be an intervening space communicating with the general peritoneal cavity between the ectopic sac and the vaginal fornix, making it both difficult and dangerous to reach the sac. In these

cases it may be necessary to stitch the sac to the abdominal wound, and then to make an extraperitoneal opening into it. As a rule, however, the sac will be attached by close adhesions to the abdominal wall above Poupart's ligament, and should be opened in this region. The sac should be washed out freely as in the vaginal method, and be packed with gauze.

The after-treatment in these cases is often of great importance, as the sac fills up very slowly and there is constant purulent discharge. The fistula must not be allowed to close. As a rule, the gauze which is inserted at the time of operation should be withdrawn one piece at a time. After the removal of the last piece, usually about the second or third day, fresh gauze should be inserted, the cavity being first freely irrigated with some mild fluid, such as boracic-acid solution (semi-saturated).

4. *Operation after the Fetus has undergone Mummification, Calcification, Saponification, or Suppuration.*—The fetus may remain for years in any one of these conditions, except that of suppuration, without injury to the mother's health. Soon after the death of an ectopic fetus the liquor amnii is absorbed, the placental circulation ceases, and the vascular connection between the fetus and the mother is broken. The liquid portion of the ectopic product is gradually absorbed, leaving in many instances the fetus isolated in its sac as an innocuous body. In such cases operation should not be performed so long as the patient's health remains good, but on the first indication of constitutional disturbance, especially if febrile in character, celiotomy for the removal of the foreign body should promptly be resorted to. If suppuration occurs and the pus-sac opens into the rectum, the vagina, the bladder, or externally through the abdominal wall, the fistula should be enlarged and the fetal débris be removed. The sac should then be irrigated frequently until it fills with granulation tissue. These sinuses heal with difficulty, and they may be persistent.

8. DISEASES OF THE FETUS IN UTERO.

Under this head only a *résumé* of the diseases occurring before birth will be noticed. There are many conditions which give to the fetus immunity to disease and to injury during the pre-natal state, such as the protection given by the liquor amnii, the uterine wall and bony pelvis, etc., but there are also many predisposing causes, such as hereditary influences from the mother and from the father, nervous disturbances, high temperatures, bad nutrition, diseases of the womb and its appendages, and certain infectious diseases, which have their influence upon the growth and development of the fetus, and which are not only accountable for disease, but sometimes also for the death and expulsion of the child before it has reached its full term. Certain tendencies to disease are inherited: this pertains more particularly to abnormal conditions of the nervous system and to disorders in nutrition. Drunkenness, epilepsy, diabetes, phthisis, and cancer of either parent are unfavorable to the health and development of the child. Frequently a fetus of such parentage dies *in utero*.

1. **INFECTIOUS DISEASES.**—Pregnancy does not give immunity to infec-

tious diseases. If the mother is suffering from one of the infectious diseases, the fetus may escape infection, but generally it suffers, either indirectly through the low state of nutrition or the high degree of temperature of the mother, or directly by a transmission of the disease itself. In either event the pregnancy may be interrupted by premature death and expulsion of the fetus, or, if the fetus is born alive, it usually dies soon after birth.

The mode of infection is often obscure, and the path or paths of its transmission are still unsettled questions. Ziemssen holds that the poison circulates in the blood. The transmission of disease-germs from mother to fetus has in some instances been demonstrated. Placental infection producing sepsis *in utero* will be considered later. Pus-organisms have been found to be transmitted to the fetus in septic disease of the mother, and well-formed collections of pus have been observed in a fetus at the time of birth.

All infections of the mother do not seem to be equally severe in their effects on the child. Pregnancy complicated by *la grippe*, cholera, diphtheria, typhoid and malarial fevers in the mother is very likely to be interrupted. It seems probable that in most of these cases the death of the fetus is produced by direct transmission of the infection from the mother, and in many cases this has been demonstrated by finding the disease-germs in the fetus.

So far as his researches into the subject have gone, the writer is not aware that there are any instances upon record of children being afflicted with diphtheria, mumps, or whooping-cough at birth; but children are born with all the pathological indications of malarial disease, such as enlarged spleen, etc., and Playfair states that the agitation caused by the chill is even felt by the mother as her child *in utero* passes through this particular stage.

Cases of congenital recurrent fever have been reported. The fetus usually dies, and shows all the pathological changes which characterize this disease—enlarged spleen, pigment in the spleen and portal blood. Albrecht reports a case in which he found the spirilla of recurrent fever. According to Bemis of New Orleans, the fetus of a woman who recovers from yellow fever is immune to the disease. As regards typhoid fever, while a pregnant woman is liable to take this infection, and the presence of the disease proves in many cases the cause of abortion, the writer does not know that there is a case on record of a child being born with unmistakable typhoid lesions. In the case of a mother affected with cholera early abortion is the rule, but if the child is born alive it usually survives but a few days. The theory of intra-uterine transmission of the bacillus is supported by the microscopical examinations of Tissot and Cattam.

2. ERUPTIVE DISEASES.—Of the eruptive diseases contracted in the prenatal state, variola, scarlatina, measles, and erysipelas have been observed in their typical form. Eruptive diseases seem to affect the child *in utero* to a greater degree than any other diseases; they are very likely to produce abortion, possibly on account of infection of the endometrium.

Scarlatina and Measles.—There are a considerable number of cases on record of children being born in the different stages of scarlatina and measles.

When scarlatina occurs in pregnancy the fetus is usually, but not invariably, infected.

The prognosis as regards both mother and fetus is grave, especially if the maternal infection occurs at or near the time of labor. Leopold Meyer mentions an epidemic in which twenty puerperal cases became infected.

Variola.—In about 50 per cent. of cases of pregnancy complicated by variola abortion takes place. In the hemorrhagic form it is almost certain to do so. Manifestations in the fetus do not always occur at the same time that they do in the mother. A case is on record where the mother in apparently good health gave birth to a child with the small-pox eruption upon it. Vaccination of the mother will sometimes protect the fetus.

Erysipelas is likely to interrupt pregnancy. Cases of intra-uterine transmission of erysipelas have been cited by several reliable authors. Lebedeff found in the fetus of a mother suffering with the disease the erysipelas coccus. Erysipelas affecting the mother in the puerperal state may be transmitted to the new-born child. The *prognosis* is more serious than that of a case outside of the puerperal condition.

Tuberculosis.—A child born of a mother suffering from tuberculosis is usually puny, feeble, and predisposed to pulmonary disease. The question of the possibility of direct transmission of tuberculosis to the fetus has recently been the subject of considerable investigation.* Several cases of transmission of tubercle bacillus from the human mother to the fetus *in utero* have been reported by Keating, Jacobi, and others. The fact that the placenta sometimes contains tubercles would show that in those cases the bacilli were introduced through the maternal circulation. From clinical observation of cases we may also deduce—(1) tuberculosis may be transmitted by either parent, and (2) that the bacilli may gain access to the fetus through the (a) maternal blood, (b) through the areas of tuberculosis, such as the peritoneum, intestines, etc., and (c) from the outer world through the genital tract.

Fetal Syphilis.—Perhaps the most important as well as the most fatal disease which affects the child *in utero* is syphilis. It is one of the chief causes of abortion.

Mode of Transmission.—Syphilis may be transmitted by either parent. If a mother who is healthy becomes infected during pregnancy, the child may escape if this infection takes place in the last month, unless the child again becomes infected at birth or while nursing.

Prognosis.—The earlier in pregnancy infection of the mother takes place, the more likely is the fetus to die. If the infection occurs during the first three months and is not subjected to treatment, the fetal mortality during the first few days after delivery reaches 100 per cent. The prognosis is a trifle better if infection occurs during the fourth or the fifth month (Étienne). As a

* The theory of congenital tuberculosis has found support in the experimental research on lower animals, also in cases of the human fetus, described by Johne (Fig. 1, *Fortschritte d. Medizin*, Bd. iii., No. 7) Merkel (Fig. 2, *Zeitschrift f. klinische Medizin*, 1884, Bd. viii.), Birch-Hirschfeld, and others.

rule, infection of the mother is safer for the fetus than infection of the father. Whether the spermatozoa of the infected father may infect the mother is undecided. All authorities do not admit the possibility of infection of the fetus unless the mother is syphilitic, but modern authorities (Tarnier, Schroeder, Charpentier, Priestley, and others) assert positively their belief in the transmission of syphilis to the ovum without infection of the woman.

Diagnosis of Fetal Syphilis.—The infection of the fetus may be inferred if either parent had acquired syphilis at a day not too far remote from the time of procreation. The limit of safety has not been discovered, but the more recently the father has suffered with this disease the more likely is he to transmit it in severe form. Often the signs of fetal syphilis can be looked for only in the fetus after its expulsion from the uterus. In many cases the child is prematurely born, and there are traces of the disease; in other cases the child is born apparently healthy, the disease developing in the course of from two to six weeks. The evidence of syphilis, whether the baby is born dead or whether the disease makes its appearance soon after birth, is usually characteristic. (Premature death of the fetus, due to syphilis, is considered on page 310.) If born alive, the child is often prematurely born, and presents during the whole of its infancy, and perhaps during childhood, a prematurely old look. There is usually marked general debility. Among the first manifestations of hereditary syphilis is snuffles. The coryza is followed by a characteristic rash consisting of erythema and erythematous patches about the anus, the genitals, the thighs, and the forehead. The upper lip is likely to become excoriated and fissured. The mucous membrane of the larynx may be affected, producing hoarseness, and there even occurs ulceration of the larynx.

Pemphigus is one of the most characteristic of syphilitic lesions. A little later roseola, the maculo-syphilides, psoriasis, vesicles, and pustules may also occur. Sometimes mucous patches appear; these may occur around the anus, the vulva, the groin, and the lips, and sometimes in the folds of the neck. Coryza may result in caries of the nasal bones. Syphilitic infants are liable to suffer from broncho-pneumonia.

Congenital syphilitic pneumonia occurs in two forms—white hepatization (Virchow) and the interstitial form. The white hepatization produces enlargement of the lungs, the cut surface presenting a mottled grayish appearance. The alveoli are filled with fatty epithelial cells. The interstitial form consists of increase of connective tissue between the alveoli; there may also be yellow induration, due to gummata on the pleural surface or scattered through the tissues.

Icterus and cyanosis are frequent symptoms of syphilis. The occurrence of the symptom of icterus is explained by syphilitic hepatitis, which in the newborn is of a different character from syphilis of the liver in the adult. Infant hepatic syphilis is always hereditary (Chauffard): the blood carrying the infection arrives in that organ, and the process is markedly profuse, rendering the organ at an early stage diffuse and massive. In the healthy infant the liver should constitute one-thirtieth part of the body-weight; in a syphilitic child

this proportion is much exceeded, in some cases having formed one-eighth of the weight of the body. The liver presents two changes—the gummata and diffuse infiltration of connective tissue. This form of cirrhosis is usually of the hypertrophic form. Cyanosis is dependent either upon premature birth or upon syphilitic changes in the lungs, for gummata and white hepatization in the lungs are found with frequency.

The tendency of syphilitic infants to hemorrhage will again be alluded to under the subject of *Hemorrhagic Diathesis*. This form is designated by Behrend as *syphilis hæmorrhagica*. It usually attacks children of premature birth who are either born dead or live only a few hours. In these children are found all the changes which characterize congenital syphilis: numerous extravasations of blood under the skin and in the internal organs, also at times great quantities of blood in the stomach and intestines, in the peritoneal cavity, and in the membranes of the brain. If such children live for a little while, then frequently new hemorrhages appear in the skin and in other organs. Ruge saw a syphilitic child present hemorrhage about the anus, at the point of the tongue, and, finally, about the eighth day of life, severe umbilical hemorrhage. The hemorrhage occurred directly out of the skin like drops of sweat. Further, upon the ninth day severe icterus developed and the child died. The autopsy showed well-developed syphilitic changes in the internal organs. Edema frequently occurs in this hemorrhagic form.

Tenderness and swelling of the long bones are strong evidence of hereditary syphilis. The most characteristic change in fetal syphilis occurs in the bones. The white line which normally marks the juncture of the epiphysis with the diaphysis becomes broader, often irregular, and yellow from fatty changes following a premature attempt at ossification; in marked cases there is also thickening of the periosteum and perichondrium. The diaphysis is sometimes sclerotic. Some authors (Müller and others) regard these processes as quite different from those of rachitis; others consider them identical. The question of identity between the two must be considered unsettled. The thymus gland is often much enlarged, and may present multiple abscesses.

The treatment of fetal syphilis is mainly prophylactic. In parents who are syphilitic the disease may be eradicated by long-continued treatment. Great benefit may be derived from treatment of the mother during pregnancy. If after thorough treatment for the disease, conception does take place, the result may be a child free from syphilis. Étienne, from a study of thirty-two cases of pregnancy in syphilitic women, concludes that the mortality of the fetus in cases where the mother has never been under treatment is enormous, reaching 95.5 per cent. If treatment be applied throughout pregnancy, we may hope to obtain complete immunity from this infant mortality. If a mother who has been infected recently, or who has had a number of miscarriages due to syphilitic infection, is again pregnant, antisyphilitic treatment should at once be instituted. Mercury and iodid of potassium are the most reliable remedies.

3. CONGENITAL DEFORMITIES AND MALFORMATIONS.—**Amniotic Bands.**
—One of the conditions to which many deformities are due is the formation of

amniotic bands. Simonart differentiates three classes of amniotic bands according to their origin and insertion—the feto-amniotic, the fetal, and the amniotic. Very often the anomaly consists only in the existence of these bands, but sometimes their existence is the cause of serious disturbance in the normal development of the fetus, giving rise either to cleavage or to strangulation, which in turn explains many of the malformations.

Adhesions between parts of the fetus and the amnion are favored by a deficiency in the amount of the amniotic fluid. If these points of adhesion become firmer or vascular, they may persist, and if the process develops at an early term of fetal life, the regular development at that point will be arrested, giving rise to morphological anomalies which consist in the failure of union between two parts, such as hare-lip, extroversion of the bladder, etc. If these amniotic bands are attached to the edge of the fetal cleavage, the cavities are particularly likely to remain open, giving rise to ectopia (Müller).

Strangulation.—Amniotic bands disturb the development of the extremities chiefly by producing constrictions, causing at the peripheral end edema or atrophy. If this strangulation takes place at a very early date of fetal life, then the growth of that part will be greatly arrested, so that the peripheral end beyond the constriction is proportionately small; in other cases it produces death of the part and the so-called "spontaneous amputation."

Intra-uterine Amputation.—It is now generally admitted that the existence of amniotic bands is one of the causes for intra-uterine amputation (Fig.



FIG. 161.—Ectromelus (intra-uterine amputation).

161). This amputation usually takes place early in fetal life. Sometimes there are a number of these bands, and they persist to the time of birth. The other causes recognized as such are inflammatory processes and intra-uterine fractures. Virchow attributes them to primary inflammation followed by cicatrix and disturbed nutrition. Simpson holds that there is a causative relation between intra-

uterine fracture and spontaneous amputation, the healing processes being unfavorable for fractures. The bone-ends may perforate the vessels and thus interrupt the nutrition of the extremity, causing a sequestrum.

Intra-uterine fractures occur occasionally, and they are usually due to external violence, notwithstanding the protection of the fetus by the amniotic fluid and the maternal body. Abnormal muscular contraction of the fetus and a diseased condition of the bones are other causes. A syphilitic osteochondritis may result in separation of the epiphysis and diaphysis of the long bones, simulating fractures. Next to external violence, advanced rachitis in the fetus undoubtedly is the commonest cause of intra-uterine fractures, which are commonly multiple. Tibial fractures are frequently associated with an imperfect development of the long bones. The intra-uterine con-

ditions are not favorable to a good union. Union may take place before birth, but usually it is a union with bad deformity. In rachitic fetuses the conditions for good union are particularly unfavorable. If these fractures remain ununited, or if they have healed, but have produced marked dislocations, they may cause difficult labor.

Congenital luxations occur in certain joints, and produce such secondary changes on the surface of the joint that in some cases restoration at the time of birth is impossible. Various joints may thus be affected, but this accident occurs most frequently in the hip-joint. In Prof. Langenbeck's clinic there occurred 90 cases of luxation of the hip-joint to 5 of the humerus, 2 of the head of the radius, and 1 of the knee. According to Krönlein, luxations are more common on one side. Luxations are apt to be associated with other malformations; they are commoner in females than in males, 87.6 per cent. occurring in females.

Etiology of Dislocations.—As to the etiology, many theories have been advanced to account for the occurrence of dislocations, of which the following four are the most plausible:

1. That it is due to true traumatic dislocation resulting from injury inflicted before birth or during delivery.
2. That it depends on a relaxed condition of the ligaments or upon hydrops of the joints.
3. That it is a deformity caused by spasmodic muscular contractions during fetal life.
4. That it is due to a malformation of the acetabulum characterized by the production of deficiency of the socket in which it is normally held.

Since in most cases of congenital dislocation the labor has been easy and natural, the first theory will hardly hold. It has also been demonstrated (Müller) that the same force which in an adult would produce a dislocation will in the fetus produce epiphyseal separation. The theory accepted by most writers as the most plausible explanation for the cases which have been examined is the fourth—congenital malformation of the acetabulum. This theory, which was advanced by Paletta, has found adherents in Dupuytren, Brechet, and most recent writers. The deformity is not usually noticed until it is time for the child to walk. The affected limb is slightly shortened. As the child grows older obliquity of the pelvis and compensatory lateral curvature of the spine may follow. Further discussion as to symptoms and treatment would hardly come within the scope of this work.

Congenital Tumors.—*Abdominal Tumors.*—The fetus occasionally presents at birth abdominal tumors of considerable size. The abdomen may be enlarged on account of ascites, which is usually of syphilitic origin. Distention of the bladder sometimes produces an immense enlargement. Other abdominal enlargements which have been observed are produced by hydro-nephrosis, dilated ureters, ovarian tumors, and carcinoma of the liver.

Sacral Tumors.—Various tumors also occur on the surface of the body, particularly in the sacral region. They may be located on the sacrum or on the

sacrum and coccyx, but usually on the coccyx alone. They are more frequent in the female than in the male. Out of 58 cases of sacral tumors, forty-four were females, fourteen males (Molk.)

The tumors vary in size and in their general appearance. We distinguish the following forms: (1) Congenital cystic tumors; (2) Congenital fatty and fibrous tumors; (3) Congenital tumors with fetal remains; (4) Caudal excrescences; (5) Attached fetuses.

The *cystic tumors* are usually hydrencephalocele or spina bifida. They occur chiefly in the cervical and lumbar regions. Fibrous tumors and lipoma occasionally occur. Sometimes these tumors contain a part or parts of a fetus. This inclusion results from a cleft in the medullary fold, that may give rise to a double formation resulting in a rudimentary tumor. These tumors may be simple or be multilocular; they may contain rudimentary limbs, cartilage, or loops of intestine. Sometimes one rudimentary fetus is attached to the palate of a fetus more developed. *Caudal appendages* occasionally occur: they may be either fibrous or bony, assuming the shape of a tail. Molk gives two such examples. Sometimes in cases of *attached fetuses* an extra limb is attached to the sacro-lumbar region; sometimes it consists of two limbs fused into one (see *Dystocia*). In these cases the pelvis usually shows some malformation.

Treatment of Congenital Tumors.—Of all these tumors the treatment is excision, but it is only indicated in cases where the attachment is not too extensive or where the growth does not to any extent encroach on the pelvic cavity or the viscera.

Deformities of Special Regions and Organs of the Body.—The influence of amniotic bands in arresting development by preventing the normal fusion at an early stage of embryonic life is now generally admitted as an explanation for such deformities as hare-lip, cleft palate, fissure of the nose, etc. Often a number of malformations occur in the same individual.

Deformities of the Face.—If the frontal process fails to unite with the superior maxillary process, which in the normal course of development unite in front of the mandibular tissues, a defect in the soft parts, producing hare-lip, may result; if the inward growth of the palatine processes is arrested, cleft palate results.

Hare-lip occurs in various degrees. Sometimes there is only a slight notch in the lip, and again there may be one or two fissures extending to the nostril, and it may or may not be associated with cleft palate. The existence of hare-lip interferes more or less with nursing, especially if associated with cleft palate. Often feeding with a spoon is unsatisfactory, because the food will regurgitate through the nose. Infants with hare-lip, as a rule, are therefore imperfectly nourished, and if they survive are likely to possess a low vitality. *The treatment* consists in sustaining the strength of the child as well as possible for the first few weeks of life; after that an operation should be performed. A consideration of the methods of operating would hardly be within the scope of this work.

Congenital occlusion of the posterior nares occurs, but very rarely. Congenital cysts of the floor of the mouth sometimes manifest themselves in the form of a swelling under the tongue or the chin.

Tongue-tie.—Very frequently the frenum of the tongue binds this organ to the floor of the mouth, immobilizing the tip of the tongue more or less. This condition interferes with suckling, and if not corrected will prove an impediment to speech. *The treatment* consists in operating, as soon as the discovery is made, by raising the tongue either with a spatula or a finger, rendering the frenum tense, snipping the membrane with scissors, and making any further separation by tearing with the finger. Care must be taken not to cut too deeply, to avoid profuse hemorrhage.

In the second part of the digestive tract strictures or pouches may occur.

Malformations of the stomach are not common. The "hour-glass" deformity sometimes occurs. Congenital obstruction of the bowel may be located in the duodenum or the jejunum, but more frequently in the ileum. Portions of the intestine may entirely be absent, or be represented only by a band of fibrous structure running along the free edge of the mesentery. Volvulus and hernia may cause obstruction.

Congenital inguinal hernia is due to a patulous condition of the inguinal canal, through which a loop of intestine protrudes.

A few cases of perforation of the intestine are recorded. In these cases death occurred within the first few hours after birth. In three cases the rupture was found at the sigmoid flexure; in one case in the splenic flexure; in one case the transverse colon was perforated. The *etiology* is tissue-necrosis, probably accumulation of meconium.

The large intestine, including the sigmoid flexure and the rectum, is liable to various malformations. The commonest malformation is obstruction of the bowel, due to deficient development. In an imperforate rectum there may be a well-defined exterior opening or it may be absent; the rectum is usually deficient to a greater or lesser degree. In imperforate anus the rectum is well developed, but the external opening is lacking. In some of these cases where the anus is absent the rectum passes into the anterior or genito-urinary segment.

Hydrocele is a not infrequent affection, and is dependent somewhat upon congenital deformity when the processus vaginalis remains patent.

Congenital defects in the generative organs of female children are not so common as they are in the male, and they are frequently not noticed until a later period in life. The defects of the internal organs are gynatresia and defect of the uterus and of the ovaries. Malformations of the organs of generation of the female are usually due either to absence of Müller's ducts, to failure of union or bicornuity, complete or partial, or to persistence of the septum, giving rise to the double formation of uterus and vagina. Persistence of the canals of Gärtner sometimes gives rise, later in life, to cysts of the vagina, and persistence of the ducts of the Wolffian body may develop into parovarian cysts.

Numerous cases of cystic tumors of the ovaries existing at birth have been recorded, but there are still controversies concerning the embryonic origin of

these tumors, some assuming that all cystic ovarian tumors are already formed in the embryo (Pozzi). This origin applies especially to the dermoid. J. Bland Sutton, who has devoted much time to the study of fetal ovaries, says: "I have never succeeded in detecting an ovarian dermoid at birth, neither can I refer the reader to a trustworthy case."

Malformations of the Extremities.—Numerical excess, supernumerary digits or toes, is another variety of malformations. The *treatment* for supernumerary digits is amputation. Congenital union of digits (syndactylism) occurs in varying degrees, there being sometimes a firm fusion of the two adjacent members, at other times a webbed condition. The fusions are *treated* by incision.

Club-foot is only a modification of a physiological position *in utero*. Too small an amount of amniotic fluid tends to produce club-foot, the foot being pressed against the breech; this long-continued pressure of the soft parts tends to shortening of the bones by retarding the progress of growth; thus the position becomes fixed (Landerer). This congenital malformation usually produces talipes varus or equino-varus. There is usually more or less paresis, and sometimes paralysis of the muscles of the affected side and tonic contraction of their opponents. The *treatment* consists in proper bandages, which should be applied as soon as the deformity is discovered.

Malformations of the Circulatory Apparatus.—Malformations of the heart are very common, especially persistence of the foramen ovale. Fetal endocarditis, with its consequent valvular lesions and transposition of the aorta and pulmonary artery, also occurs. Sometimes there is but a rudimentary septum between the ventricles. As this system resembles the arrangement of the heart of the lower forms of life, it is called "reptilian heart." Persistent cyanosis is the most marked symptom of these malformations. Frequently the fetus is not viable.

Malformations of the Brain and Cord.—*Cerebral hernia*, or *meningocele*, is a tumor varying in size from a hazel-nut to that of a child's head. It occurs usually on the occiput, occasionally at the root of the nose or on one of the fontanelles.

Spina bifida, which is not uncommon, may occupy any part of the length of the spinal column. It is a congenital malformation in which the laminae fail to unite in one or more of the vertebrae, allowing protrusion of a sac composed of the spinal cord or its membranes. If the spinal membrane only protrudes, it forms spinal meningocele; if the cord and spinal nerves as well as the membranes protrude, they form meningo-myelocele; if in the latter protrusion the spinal canal is dilated, forming a sac, it forms syringo-myelocele.

Exencephalus is a deformity in which the brain is present, but the cranial bones are not developed. *Pseudencephalus*, in which the bones of the cranium are absent or are undeveloped and contain a rudimentary brain, is a more common deformity than *anencephalus*, in which there is no brain and no development of the cranium. *Acephalia* and *hemicephalia* are deformities consisting in a defect of the skull; sometimes the defect continues into the spine. The integument and nerve-tissue are wanting, and are replaced by

some granulation tissue. The *etiology* is unsettled, although several theories exist. A fetus with this malformation is usually not viable; if there is life at the time of birth, it soon ceases. These deformities may occur successively in several pregnancies. *Microcephalia* is a monstrosity with a very small skull. The forehead is flattened and receding. Monstrosities of this class may be viable; if so, they are imbecile. They may live for some time, and may even attain great age.

Excessive Development.—Excessive development of the whole fetus occasionally occurs, in which the fetus has weighed from fourteen to eighteen pounds (A. Martin, Beach, Meadows); the more frequent cause, when the excessive development is not very great, is prolongation of pregnancy; other causes are multiparity and excessive size of one or both parents; again, there are cases in which the fetus as a whole does not exceed in weight the normal limits, but there is an excess of development in some particular member of the body, especially one of the extremities. In such hypertrophies of the fingers and toes, if the deformity is sufficiently pronounced to prove a hindrance, amputation is indicated.

Double Formations.—Authorities do not yet fully agree concerning the cause of formation of homologous twins and double monsters. It is generally accepted that both originate from one blastula of the yolk. It is still a question of dispute whether the blastoderm membrane presents two germ-inative areas, which later fuse more or less into one being, or one area, which becomes more or less divided.

As union may take place in the cephalic, the median, or the caudal extremity of the embryo, one of these forms of monstrosities may result (Müller). They are accordingly named cephalopagus, thoracopagus, ischiopagus, etc. Of these classes various modifications occur. Figure 162 represents an interesting specimen of thoracopagus, exhibited by Dr. W. W. Jaggard before the Gynecological Society of Chicago. If there is an unequal development of the embryos, one may seem nearly normal, while the other is quite rudimentary and seems to form but an appendage to the former. Such a rudimentary fetus may even become completely enclosed by the larger one (Müller).

4. **MATERNAL IMPRESSIONS.**—There exists a popular belief, which was particularly prevalent during early times, that the peculiar sensations, emotions, sights, etc. experienced by a pregnant woman are frequently transmitted to her child, and if these sights and impressions are particularly frightful, they cause marks and defects on the child. One of the arguments

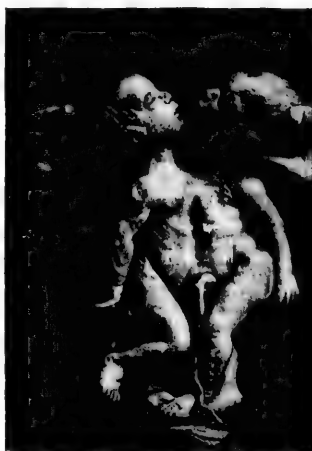


FIG. 162.—Thoracopagus (double formation).

advanced in favor of this view is that a belief so universal and adhered to through centuries is rarely entirely fallacious, especially when the subject is based upon observation. The advocates of this theory adduce one of their most reliable arguments from the Scriptures (Gen. xxx. 37-39): "Jacob took him rods of green poplar, and of the hazel and chestnut tree; . . . And he set the rods which he had pilled before the flocks in the gutters in the watering-troughs, . . . that they should conceive when they came to drink. And the flocks conceived . . . and brought forth cattle ringstraked, speckled, and spotted."

At the present time authors, practitioners, and teachers differ, but up to the beginning of the eighteenth century they were nearly unanimous in the belief that fetal marks, deformities, and lack of development were due to impressions received by the mother. Wherever the truth may lie, it is very evident that many of the cases cited have been taken from individuals whose testimony would hardly pass as conclusive in other matters.

During the past forty years many articles have been written strongly opposed to the previously accepted theory of maternal impressions. It has always been extremely difficult to demonstrate that any deformity or mark or lack of development in the child was due to an impression which the mother may have received before its birth, inasmuch as there seems to be at least one unanswerable argument in that we find no direct nerve-connection existing between mother and child.

The late Fordyce Barker has been credited with demonstrating the correctness of the theory of "maternal impressions" in a paper read in 1886 before the American Gynecological Society. He quotes freely from physiologists to show that the weight of authority must be conceded to be in favor of the doctrine that maternal impressions may affect the growth, form, and character of the fetus. His opinions, however, were very largely based upon references and arguments adduced from older writers. Barker, in concluding, quotes the following from the *British-American Journal*: "When, in the early weeks, structural development is proceeding at no tardy rate, an interference to nutrition of the mother cannot but impress the fetus detrimentally, and the organ interfered with would be that one in the condition of the most active development, or that which could less easily bear any arrest, however transient, with impunity." Again: "Then, too, although no nervous connection has been demonstrated to exist between the mother and the fetus, yet the latter possesses nerves; and alterations of the nutrient power of the mother cannot but act on the nerves that are governing, though it may be only to a slight extent, the growth of the fetus itself." As a matter of fact, only a few cases—exceedingly few—of defective or marked children are born compared with the multitudes of perfect ones; then, too, the testimony in many of these cases is absolutely worthless.

One of the ablest articles opposing this theory is written by J. G. Fischer. A few of his conclusions, and those epitomized, will be given. They are briefly as follows: That traditional superstition has perpetuated the notion,

and that the medical profession is in no considerable degree responsible for its continuance; that intense emotions and apprehensions are experienced, and malformations are expected by many gestating women, yet the abnormal births are extremely rare; that there is no law in the alleged result, and that the occasional apparent relation of cause and effect is due to accidental coincidences.

There is, in addition, against the theory, another argument, which is that the assumed causes are alleged to have operated upon the embryo subsequently to the named period for the evolution of the part which is found to be the site of the malformation, implying not only a formative process, but a retro-formative power. This argument, it appears to the writer, is particularly strong. For instance: a child is born with a profuse growth of hair upon a spot of the body where it should not exist. The mother and her friends, after considerable coaching, remember that some of the impressions somewhat similar to this were received at a certain time. As a matter of fact, that time occurred a considerable period after or before the period when, according to the study of embryology, we know the hair to have been developed.

Several years ago Norman Bridge wrote a strong paper against the theory. Among other things, he says: "To endow the blood with such a weird intelligence as this would require is too great a load for our credulity. There is no philosophy that it so acts. There is possibly enough in this theory so that we should, on account of the comfort of the pregnant woman, advise her not to indulge in violent emotions, or to see peculiar sights, or to do anything which is outside of the proprieties of life." It is desirable, in the writer's judgment, to give this advice to all pregnant women.

Many cases have been brought forward that seem almost to prove the position assumed by both parties in this controversy. In the writer's judgment, nothing is really established, and we must continue to believe that if a pregnant woman sees a sight and gives birth to a marked baby, it is usually only a coincidence. We must still regard the relation of cause and effect as largely an accidental coincidence bearing in mind, however, the fact that, exceptionally, very profound emotion can and does in some unknown manner influence the growth and development of the fetus.

5. INTRA-UTERINE DISEASES OF THE BONES.—*Rachitis* of the new-born occurs in two distinct forms—the fetal and the congenital. Although rachitis as it occurs in early childhood was recognized by the ancients, it is only recently that the existence of the fetal form has been fully recognized and described. Since Bohn and Winckel described these two forms the investigations of Virchow, H. Müller, and others have given support to this classification. Both forms originate in the pre-natal state, but in the fetal form the disease-process is fully developed at birth; in the congenital form it continues to develop.

Fetal rachitis (Fig. 163) has been characterized as a disease of the periosteal cartilage, giving rise to an active growth in the wrong direction; at the same time there is a deficiency in the deposit of calcareous matter. In rachitis the cartilaginous and subperiosteal cell-growth is excessive and irregular, while the process of ossification itself is also irregular and sometimes wanting

(Fig. 164). The line of ossification between the epiphyses and diaphyses is irregular, likewise is the zone of calcification; newly-formed bone- and marrow-cavities may be in the midst of cartilage, and masses of cartilage may take the place of bony tissue. At the same time there is an excessive proliferation of cells on the inner layer of the periosteum; these various abnormal processes lead to bony deformities. The long bones develop more laterally than longitudinally; the extremities are short, thick, and usually curved; the skull-bones are thick; the ribs show nodular enlargement (beaded ribs); deformities occur in the spinal column and pelvis, and the thorax shows the "pigeon breast." There is a general disproportion between different parts of the body. The head is often large, the neck thick and short, the abdomen large. Associated with these characteristics we may find hydrocephalus and enlargement of the thyroid gland.



FIG. 163.—Fetal rachitis.

Reference has already been made (page 300) to the frequent occurrence of intrauterine fractures in cases of congenital rachitis.

There are other conditions which affect the growth of the skeleton *in utero*, and which resemble rachitis—Schmidt's, Bidder's, and Müller's diseases.

Bidder's Disease.—In Bidder's disease (osteogenesis imperfecta) the lines of ossification are normal; the epiphyseal cartilage is normal, but



FIG. 164.—Skull (front view) in fetal rachitis; absence of frontal bone.

ossification does not fully take place either in the epiphysis or in the diaphysis. The bone-production from the periosteum is commenced, but in the diaphysis the compact portion is imperfectly developed; in the marrow-cavities there is no deposit of calcareous substance. The bones remain short and pliable; the sagittal suture remains broad. The bones of the face and skull are particularly apt to be affected. Sometimes this condition affects in a slight degree the bones of the skulls of infants who are otherwise perfectly developed.

Schmidt's disease is characterized by great predisposition to fracture of the bones. The periosteum and the epiphyseal cartilages are normal, but the bony canulæ do not present the concentric arrangement which normally exists.

The bone-corpuscles are large, and usually remain empty. The spongy substance contains much connective tissue and many undeveloped cells.

Müller's disease is a diseased condition of the cartilage. The embryonic development of cartilage, which normally extends chiefly in a longitudinal direction, expands in all directions; at the same time the development of bony structure from the periosteum continues. This action leads to the production of thick, short bones. The skull-bones are also very thick.

6. INTRA-UTERINE DISEASES OF THE SKIN, CONNECTIVE TISSUE, AND SEROUS MEMBRANE.—Diseases of the skin, the connective tissue, and the serous membrane that manifest themselves in the pre-natal state are usually due to fetal syphilis. Cases of congenital ichthyosis, pemphigus, and other eruptive diseases have also been observed.

Pemphigus.—Pemphigus neonatorum in its epidemic form is considered on another page; it must not be confounded with the congenital form. Although the pemphigus is usually syphilitic when present at birth (Roeser says always), still some cases of non-syphilitic pemphigus have been observed. Erysipelas has been observed to be transmitted to the fetus *in utero*.

Anasarca.—Under this head belong hydrothorax, ascites, and hydrocephalus. These conditions often produce mechanical obstruction to delivery. Occasionally anasarca is seen in connection with dropsy of the mother. This condition is frequently due to obstruction of the umbilical vein accompanying syphilis. Excessive distention of the body may result from ascites and hydrothorax. Ascites is often due to syphilis; also to organic lesions of the heart.

Tumors.—Among congenital tumors of the skin, nevus is the most common. Although not always noticed at the time of birth, the nevus is probably always present at that time. These tumors belong to the angiomata. Hairy and pigmented moles often occur congenitally.

Peritonitis.—Fetal peritonitis is usually due to syphilis. It manifests no symptoms at this period, but if not destructive to the life of the fetus, it is likely to produce some constriction of the bowel. It also occurs in infants in connection with puerperal fever, especially in lying-in hospitals. The pathological conditions correspond with those found in similar cases in adults.

Pericardial and endocardial inflammations rarely occur, and the latter is more often located in the right side of the heart, and may leave lasting valvular changes.

7. STRUMA.—Struma of the thyroid gland must not be confounded with edema of that structure. While edema occurs as a traumatic injury, true struma is an hypertrophy of the thyroid. Edema results from face presentation; hypertrophy may produce the same. Struma may be complicated with edema, which, however, will only be temporary.

8. INTRA-UTERINE DISEASES OF THE NERVOUS SYSTEM.—There are of the brain a number of defects which are congenital in their origin, and which later manifest themselves as some forms of deaf-mutism, cretinism, idiocy, and other forms of partial or complete loss of development. Hypertrophy of the brain sometimes occurs, associated with rachitis.

Hydrocephalus.—Fetal hydrocephalus is not common and its etiology is not understood. According to Meigs, it is due to an inflammation of the lining of the ventricles. It often produces a hideous deformity, due to protrusion of the eyes and projection of the forehead (see page 259).

Cretinism is endemic in some mountainous districts of Europe. It is often associated with enlargement of the thyroid gland.

Syphilitic Idiocy.—Manifestations of syphilitic idiocy are recognized after the period of infancy.

9. **DEATH OF THE FETUS.**—In presenting this subject a repetition of what has been said under *Abortion* (page 259) can hardly be avoided.

The causes resulting in death of the fetus before maturity may be considered under the following heads:

- (1) In the father,—alterations of semen, as in phthisis, albuminuria, etc.
- (2) In the mother,—general diseases, excitability of the uterus, and marked lesions of the same.
- (3) In the fetus—or faulty development.
- (4) In the annexes of the fetus—membranes, placenta, cord.
- (5) External violence.

(1) *Causes resulting from the Father.*—Conditions producing great debility in the father are liable to manifest themselves in a low degree of vitality in the offspring, and often before the time of birth produce death in the embryo. Old age in the father, chronic poisoning, albuminuria, and phthisis are likely to be followed by this result, but the most frequent cause from the parental side is the transmission of syphilis from the father. The embryo may show signs of this disease without the mother being infected.

Death of the fetus is explained in various ways. The fetus itself may be of low vitality, or the membranes may become affected in a way to interrupt life. Syphilis may produce hypertrophy of the villi of the chorion (Schroeder), producing sufficient pressure on the maternal vessels to render imperfect the interchange of nutrition between mother and fetus. The more recent the infection of the parent the more likely is it to produce death of the fetus and abortion. Rupture of one of the viscera may cause death of the fetus. J. W. Ballantyne cites three cases in which rupture of the spleen was the immediate cause of death within two days of delivery. One case occurred during Prof. A. R. Simpson's service, and the post-mortem examination was made by the writer; death occurred two days after labor. The second case is one reported by Charcot (1858), in which a stillborn infant had been resuscitated and lived half an hour. The third case was reported by Kleinwächter (1872): a prematurely born infant, weighing four and a half pounds died in four hours.

2. *Causes resulting from the Mother.*—The influences from the mother leading to death of the fetus are numerous. Acute infectious diseases of the mother come under this head. It has been demonstrated that high temperature and anemia of the mother are liable to interrupt gestation by premature uterine contraction. Tuberculosis, carcinoma, nephritis, and diabetes of the mother often cause peculiar excitability of the embryo; the nervous system of the

mother will likewise bring about this condition, the motor nerves responding to very slight irritation and setting up uterine contraction. Phthisis of the mother sometimes produces premature labor, sometimes abortion. Death of the fetus on account of tuberculosis of the mother is not usual, but frequently the child is poorly developed, and if it survives remains feeble. Whether this feeble condition is due to lack of resistance or to intra-uterine or latent disease cannot now be decided.

Conditions of the uterus and its immediate surroundings may interrupt pregnancy; especially is this true of endometritis and all inflammatory conditions of the parenchyma. Conditions which interfere with the expansion of the uterus, such as versions, flexions and adhesions, and neoplasms, also sometimes interrupt pregnancy, but usually the uterus overcomes the resistance by degrees. The presence of uterine fibroids is more likely to interfere.

3. *Causes resulting from Faulty Development of the Fetus.*—As regards the fetus itself, anasarca sometimes results from disease of the mother, sometimes independent of the same; it may cause premature birth and expulsion.

4. *The Annexes of the Fetus.*—Membranes, placenta, and cord, degenerations of the placental villi, extravasations and effusions of blood into the placenta and membranes, will more or less interfere with the nutrition of the embryo, causing partial or complete separation of the placenta. Amyloid and fatty degenerations of the placenta will produce the same result; likewise any condition which interrupts the circulation of the cord must be disastrous to the nutrition, and eventually to the life, of the fetus.

Dropsy of the amnion (hydramnion), or an excessive amount of fluid in the amniotic cavity, is not uncommon. When it exists in a marked degree, it will produce death of the fetus, though the latter may have advanced to maturity. Knots in the umbilical cord may produce sufficient change in the circulation to materially affect the fetus (Fig. 165). Lefour, who experimented with reference to knots of the umbilical cord on the fetus, concludes that "the influence of mere knots apart from compression is slight. When the intravascular compression increases the cord becomes turgescient and tends to loosen."



FIG. 165.—Knotted cord.

When death of the fetus occurs in successive pregnancies the term "habitual death" is applied. Some authors apply the term only to those cases in which abortion occurs repeatedly at the same stage of pregnancy. Schroeder would apply the term only to cases occurring repeatedly at about the same period and associated with no apparent anatomical changes in the mother, the embryo, or the membranes—that is, when the interruption is brought about

merely through excessive irritability on the part of the mother. Most authors, however, give as causes for habitual death of the fetus, first, syphilis, the most common, then maternal anemia and uterine disease.

5. *External Violence*.—The differential diagnosis between death produced by external violence and that produced by natural causes is of medico-legal interest, but does not properly belong to this work.

10. *POST-MORTEM CHANGES OF THE FETUS IN UTERO*.—The changes produced in the fetus by pre-natal death are characteristic, and usually are markedly different from those produced after birth. A number of post-mortem changes may take place; in the main, the changes vary somewhat with the period of development. If pregnancy is interrupted during the first few weeks, the embryo is usually not much altered, is small, and is generally surrounded by very little fluid.

If the fetus dies during the first months of gestation and the ovum is not expelled, some weeks afterward the latter may be found containing no trace of the embryo. The total absorption of the fetus assumed by many writers is doubtful; according to Müller, it does not occur frequently, and probably is possible only at a very early period of development. He assumes that in many cases where no trace of the fetus is found it has either passed previous to the expulsion of the membranes, or has been liquefied and is passed in a state of dissolution. The membranes may show signs of decomposition or may contain extravasations of blood. If the vitality of the chorion has been retained for several weeks or months, it will result in a "mole pregnancy."

After the fourth month of gestation the possibility of unobserved escape of the fetus or that of liquefaction no longer exists. At this period the fetus is either retained without change or it undergoes one of the following changes: 1. Maceration; 2. Saponification; 3. Mummification; 4. Putrefaction; 5. Suppuration; 6. Calcification.

Maceration (*Fœtus sanguinolentus*, E. Martin) is the most common of the post-mortem changes of the fetus after the fifth month; it rarely occurs at an earlier period of development. The fetus is usually discolored, brownish, and livid; some of the epidermis shows bullæ; these may contain a yellowish fluid, or if ruptured the red corium is exposed. The thoracic cavity is usually small, the abdomen large, containing bloody fluid, and all tissues, muscles, and bones are softened. The umbilical cord is dark, and Wharton's jelly is distributed irregularly. The placenta is also softened and saturated with bloody serum; the chorion and decidua show necrosis. In some cases occur the characteristic changes of syphilis, osteo-chondritis syphilitica being especially marked in the lower epiphysis of the femur. Associated with this may be a condition designated by Buhl "lipoid degeneration." Literature contains but one case of this change, it being fully described by Buhl. In this case the muscular, adipose, and bony structures were unchanged, but the cavities were lined with a thick caseous matter, which in microscopic examination showed crystals of margarín. According to Buhl, this process must not be confounded with that of "saponification."

Saponification.—The process of "saponification," described in older books, comes probably under the head of mummification.

Mummification.—This change may be regarded as the typical post-mortem change of the fetus when death takes place between the third and the sixth month. The fetus is shrivelled, the tissues are dried, the skin is gray and shows the outline of the skeleton. If such a fetus has been retained for a long period and is subjected to pressure, it sometimes becomes desiccated and flattened like a sheet; such a change is designated by the term *fetus papyraceus*. Twin pregnancy is most likely to produce such a change when one embryo dies and the other continues to live and develop. The placenta is also dehydrated, and there is no amniotic fluid. This fluid has either been drained off or has been absorbed by the chorion. Mummification is more likely to occur in cases where the cord is twisted about the neck of the fetus. If the fetus attains the age of several months before death takes place, it is likely to undergo one of the two changes, putrefaction or suppuration. Both these changes are due to the entrance of germs, which is more liable to occur after the rupture of the membranes, so that germs are admitted from without.

Putrefaction.—The process of putrefaction differs from that of maceration. It is characterized by the presence of a foul odor and by the production of gas—sometimes in great amount (physometra or tympanites uteri).

Suppuration is often associated with putrefaction. The changes which the fetus undergoes in ectopic gestation have been referred to under that head.

Calcification.—A dead fetus remaining in the uterus or in extra-uterine cysts for a longer period may become infiltrated with calcareous matter until it resembles a stone. Such a fetus is termed a *lithopedion* (p. 283). Cases are on record where the fetus has been retained in this state for many years. Lusk cites a case in which the woman was supposed to be pregnant, and labor ceased with the expulsion of a child. Thirteen years later Lusk removed a calcified fetus.

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III. LABOR.

I. THE PHYSIOLOGY OF LABOR.*

Definitions.—Labor is the complex process by which the ovum is severed from its connection with the mother and extruded or extracted from the maternal organism. The term *normal labor* (eutocia) may be restricted to labors with normal factors that are terminated by the natural forces, or it may be narrowed down to include only vertex presentations in anterior positions under right conditions. *Dystocia*, or difficult labor, includes all forms of abnormal or complicated deliveries near term. *Premature labor* refers to the premature birth of a fetus which has reached the period of viability or of sufficient development to live independently of the mother. *Miscarriage*, or immature delivery, is usually restricted to the expulsion of the fetus from the third month until viability, although it is often used as a synonym of *abortion*, and is the lay term for that event, "abortion" to the layman denoting criminal intent. The word abortion is reserved for the expulsion of the ovum in the first three months.

Causes of Onset of Labor.—What constitutes maturity or ripeness we do not know, and in the indefiniteness of our knowledge "we refer the matter to a law of the organism—a law the cause of which we do not know."

The termination of pregnancy is due to some combination of conditions, no one of which, singly, will account for the occurrence of labor at two hundred and eighty days after the date of appearance of the last menstrual period. Briefly stated, the chief factors are—

1. Increasing irritability, with strengthening intermittent contractions.
2. Changes in the decidua—loosening, thinning, and thrombosis.
3. Excess of CO_2 and lessened oxygen in the placental blood acting on the motor centre for the uterus in the medulla.
4. Increasing tension on fully-developed muscular walls.
5. Stronger fetal movements in more confined space.
6. Partial relaxation of the cervix.
7. Menstrual periodicity (tenth period).
8. Habit and heredity.
9. Exciting cause—exercise, strain, emotion.

1. A steadily increasing irritability is probably the rule during gestation. At certain menstrual epochs, such as the second, third, and seventh, it is especially marked, and there is evident disturbance both of the neighboring nerves and of uterine ganglia in the first and last trimesters.

Intermittent contractions occur regularly in the non-gravid uterus, they

* The superior figures ⁽¹⁾ occurring throughout the text of this section refer to the bibliography given on page 340.

are distinct from the very beginning of pregnancy, they steadily gain in strength during its progress, and at its end hardening and prominence during contractions may always be found. The dividing-line between contractions and true labor-pains is not easily drawn, and as soon as the ovum becomes a foreign body by beginning separation more vigorous action is ensured.

2. The changes in the decidua are well epitomized by Lusk:¹ "The researches of Friedländer, Kundrat, Engelmann, and Leopold have demonstrated that the decidua vera of pregnancy is distinguishable into an outer dense, membranous stratum, composed of large cells resembling pavement epithelia, probably metamorphosed cylindrical cells, and an—in appearance—underlying meshwork, formed from the walls of the enlarged decidual glands. It is in this spongy layer that the separation of the decidua takes place, the fundi of the glands persisting even after the expulsion of the ovum. By many a fatty degeneration of the cells of the decidua has been observed toward the end of pregnancy, but Leopold, Dohrn, and Langhans have shown that this is not of constant occurrence. The trabeculae which enclose the spaces of the network diminish in size with the advance of pregnancy. Thus, while they measure at the fourth month about $\frac{1}{500}$ of an inch in thickness, they become gradually reduced in the subsequent months to $\frac{1}{2500}$ of an inch—a change which materially facilitates the peeling off of the decidual surface.

"From the fourth month onward large-sized cells make their appearance in the serotina, especially in the neighborhood of thin-walled vessels. The largest of the so-called giant-cells contain sometimes as many as forty nuclei. Though a physiological product, they resemble for the most part the so-called specific cancer-cells of the older writers. They are of special obstetrical interest from the fact, observed by Friedländer and confirmed by Leopold,² that they penetrate the uterine sinuses from the eighth month, and lead to coagulation of the blood and to the formation of young connective tissue, by means of which a portion of the venous sinuses becomes obliterated before labor begins. The subtraction of these vessels from the circulation tends to increase the amount of the venous blood in the intervillous spaces of the placenta."

3. Brown-Séquard found by experiment that an excess of CO_2 circulating in the blood of a gravid animal excited uterine contractions, and he claimed that this excess of the gas was the proximate cause of labor. His theory lacks conclusiveness, however, because it does not explain why the CO_2 postpones its irritant action until the end of the ninth month. Leopold believes that the excess of CO_2 in the placental blood is the result of venous hyperemia of the placenta, produced by the spontaneous thrombosis in the veins of the placental site at the end of pregnancy, while Hasse credits it to certain changes in the circulation of the fetus—chiefly in the crossing blood-currents of the right auricle and shrinkage of the ductus venosus and arteriosus. Spiegelberg teaches that at maturity the fetus requires some new substance not supplied by the placenta, and that it dies (as in extra-uterine pregnancy) if it does not obtain it, while chemical substances no longer required accumulate in the blood and act as irritants to the special nervous centres.

4. Power in 1819 called especial attention to over-distention of the uterus as a causative factor in labor; it can admirably be demonstrated by analogy. As the over-loaded stomach or the rectum rejects its burden, so the over-distended uterus rebels and expels its contents by the contractions of labor when the mouth of the organ begins to be distended. The occurrence of premature labor in hydramnion and multiple pregnancy sustains this theory, but, on the other hand, it does not account for labor-pains in extra-uterine pregnancy. The extensibility of the uterine wall has a limit, and when this is reached the ovum in its growth presses more and more upon the internal os. This pressure excites a special set of nerves and brings about uterine contractions, just as the contact of the drop of urine at the neck of the distended urinary bladder excites contraction and evacuation of that organ.

A theory of this nature brings up the question of the innervation of the uterus. Through what set or sets of nerves does the uterus receive its motor impulses during labor? The nerve-supply is largely from the hypogastric and ovarian plexuses of the sympathetic system. The cervical ganglion receives, in addition to its extensive connections with the sympathetic, filaments from the second, third, and fourth sacral nerves. But Lusk and Jacquemart report cases of successful labor in patients suffering with paralysis of the lower extremities, retention of urine, and incontinence of feces—a state of affairs which would lead one to discount the importance of the rôle played by the filaments from the sacral nerves. On the other hand, the experiments of Schlesinger³ argue against the exclusive source of motor-supply resting with the sympathetic, for he was able to elicit reflex movements of the uterus by stimulation after severing all the branches of the aortic plexus. Whether he may not have overlooked some of the slender nerve-filaments in cutting the branches of the aortic plexus is a question worthy of consideration, and the possibility of such an error detracts from the value of his experiments and the weight of the conclusions to be drawn from them. The uterine ganglia have a certain independence of action, such as the cardiac ganglia possess, since rhythmic contractions by both may be kept up after separation.⁴ Brandt has shown that massage of no part of the pelvic contents will produce contraction in the non-gravid uterus so rapidly as manipulation of the (supravaginal) cervix, and the writer has demonstrated this for the early weeks of pregnancy.⁵

Whatever the channels of nerve-force may be, there has been proved to exist in the medulla oblongata a motor centre for contraction of the uterus that may be excited to action by CO_2 in the blood, by anemia, and perhaps by the toxic substances retained in the blood of one suffering from nephritis. At full term something stimulates this centre to activity, with a complex, co-ordinated set of muscular contractions as the resultant. Moreover, it is supposed by Schatz that the uterus possesses an inhibitory centre which is active throughout pregnancy, but which for some reason ceases to act at term.

6. A diminished resistance in the lower birth-canal is to be noted. The cervix is fully softened, the pelvic floor is edematous and relaxed, and the uterus and its contents often sink low in the pelvis.

7. The theory advanced by Tyler Smith to the effect that the tenth period of ovarian excitement incites the nervous apparatus of the uterus to activity is of some force, since pregnancy is often interrupted at menstrual epochs; but it is open to the same objection as that just mentioned, for it does not make plain why the ninth or eleventh period fails to effect the same result. Moreover, single ovariectomy has been performed many times, and double ovariectomy a few times, during pregnancy, without perceptibly influencing its course.

8. Many multiparæ follow the same rule in a series of pregnancies. In other cases great variations are seen.

9. Finally, with all things ready, an unimportant, perhaps accidental, occurrence, such as slight increase in intra-abdominal pressure from walking, stair-climbing, coughing, or straining at stool, as well as any mental irritation (anxiety, care, anger), may be the exciting cause.

We have been dealing, then, with determining causes, factors in a phenomenon, none of which can establish a claim to be considered singly and absolutely causative. Winckel sums up by saying that labor is the total of several causes which may enter into different combinations to accomplish the same result. Lusk takes substantially the same ground, and Barnes observes that the determining causes act synergetically, not singly.

The fetus is mature, ready to undertake the complex acts of respiration and digestion; the imperceptible uterine contractions of several weeks have loosened the attachments of the decidua, whose trabeculae have grown much thinner and capable of easy rupture; the uterus by distention, perhaps by increasing pressure of the fetus on the internal os, has grown very irritable, the lusty inmate augmenting this condition by the force and frequency of its movements. The maternal blood contains an increased quantity of CO_2 ; venous thromboses in the uterine wall near the serotina and in the serotina itself obstruct the circulation and cause stasis of the maternal blood returning from the placenta; the cervix uteri becomes soft and dilatable; the advent of the tenth menstrual date, with increased congestion and irritability of all the generative organs as a consequence, adds fuel to the pile; the unknown factor deposits the spark at the centre of uterine contraction in the medulla, and labor has begun.

THE PHENOMENA OF NORMAL LABOR.

The physiology of the processes concerned in the expulsion of the fetus includes a study of the action of the uterine walls, the uterine ligaments, the abdominal muscles, and the vagina; the changes induced by labor in the cervix, in the lower uterine segment, and in the body of the uterus; the variations in the presenting pouch of membranes; and the character of the liquor amnii, the formation of the caput succedaneum, and the changes in the pelvic floor. Then the clinical character of the three stages of labor will be considered, leaving questions of mechanism and management for later sections.

Uterine Contractions.—The uterine contractions of labor go by the name of "pains" in all languages, including the speech of the scientist, because of the suffering inseparably associated with them. The cause of this suffering

is the compression of the uterine nerves between the contracting muscular fibres, the tension of the external os and lower uterine segment, the stretching of the uterine ligaments, and the pressure of the advancing fetus on the nerves of the vagina, the vulva, and the neighboring structures. Moreover, hyperemia of the lower end of the cord and its envelopes is probably in part responsible for the distress.

The location of the pain is, at first, in the lumbo-sacral region, and later in the abdomen or down the thighs. The most severe degree of pain is felt at the vulva as the head passes. The onset of the contraction is more rapid than the decline. The pain begins suddenly a few seconds after the beginning of the contraction—as may be seen by the bulging forward of the fundus or be felt by the examining hand—reaches and retains for a few seconds its acme of intensity, and then gradually subsides. If each pain be divided into periods of increase, acme, and decrease, the acme will occupy the greatest length of time of the three divisions, the total duration of a pain being about one minute. The suffering is commonly more severe in very young or in elderly primiparæ than in those in the prime of physical life. Susceptibility to pain, and general vigor, have much to do with the amount of anguish experienced, it being among serene women and dull-witted and sturdy-limbed hospital patients that we oftenest see quiet labors. Painless deliveries have been reported, but they are rare.

The muscular fibre of the uterus is non-striated, and the contractions, as in all organs of like histological structure, are *peristaltic, involuntary, and intermittent*. Contractions sweep over the uterus in a peristaltic wave, probably travelling from the opening of the Fallopian tubes down to the cervix, reaching a swift acme, and subsiding within twenty or thirty seconds. Waves in both directions have been observed in the uteri of some of the lower animals. Though mainly controlled by the sympathetic system of nerves, and hence independent of the will, the pains are nevertheless influenced to some extent by the brain—a fact demonstrated by the effect of fright or of excitement in retarding or even in stopping labor. The pains last from thirty to ninety seconds, and the peristaltic action from twenty to thirty seconds; the interval is about thirty minutes at first, whereas at the end of labor it is but two to three minutes, and nearly disappears as the head emerges. Symmetrical pains often occur in groups, followed by shorter or almost abortive pains. As to the *force exerted*, the pressure during the height of a pain never exceeds 100 millimeters (4 inches) of mercury, the average being 60 millimeters ($2\frac{3}{8}$ inches; Schatz). Leaman measured the force with which the head advanced (not the force with which it was propelled), and found a high pressure to be five pounds. Forceps was required where it did not exceed two and a half pounds.⁶ The force of the pain remains about the same during the entire labor, or it may increase by a fourth, and this with no regard to weariness on the part of the patient. The force does not increase with the resistance offered, but the pains simply become more frequent and last longer. The type of the pains is nearly constant in the same patient (Schatz).

The amount of force exerted by the pains is supposed to range between seven-teen and eighty pounds. Our methods of measuring, however, are defective. Duncan and Poppel, who studied the force required to rupture the membranes, found that in easy cases it was hardly more than the weight of the child, and only in severe cases did it rise to fifty pounds. Schatz⁷ passed a rubber bag into the uterus during labor and connected it with a gauge, registering fifty-five pounds as the maximum. An obstetrician knows that all the muscular power he possesses is sometimes insufficient to prevent rapid expulsion of the head.

The changes in shape in the uterus during contraction are marked. In the quiescent state it rests against the spinal column, ovoid in shape, the transverse exceeding the antero-posterior diameter. During contraction these diameters be-



FIG. 166.—Palpation of the cervix before labor. The two rings are shown, with the finger-tip touching what may be called clinically the "internal os" (one-half natural size).

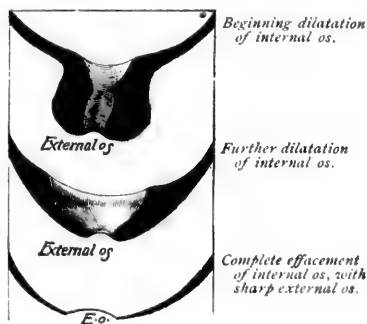


FIG. 167.—Diagram showing the sensation to the examining finger of widening and effacement of the internal os during dilatation of the cervix, and the knife-like edge of the external os (one-half natural size).

come about equal, the uterus assumes an ovoid or somewhat cylindrical form, and by means of this increase of the

antero-posterior diameter and the contractile action of the broad and round ligaments the fundus is forced forward against the abdominal wall. At the same time the uterus becomes longer at the expense of the lower uterine segment and the cervix (Fig. 236, p. 425).

Action of the Ligaments.—The uterine ligaments—the round ligaments, the lower part of the broad ligaments, and the utero-sacral bands—contain much muscular tissue which is directly continuous with that of the uterine wall. Contraction of this muscular tissue occurs with each pain, and serves to fix or to steady the uterus in position at the brim, and to assist in lifting and

holding it at an angle favorable for expulsion of the fetus (Fig. 211, p. 388).
Action of the Abdominal Muscles.—Next to the uterine contractions the force of the abdominal muscles is the important expulsive agent. We include all those muscles that fix the thorax and pelvis or narrow the abdominal cavity. The resultant of the forces of these muscles lies parallel with the axis of the superior strait (Winckel; see Fig. 211, p. 388). The action

on the part of the woman is voluntary at first, but becomes less so as labor advances, as shown by her inability to withhold strong pressure at the time

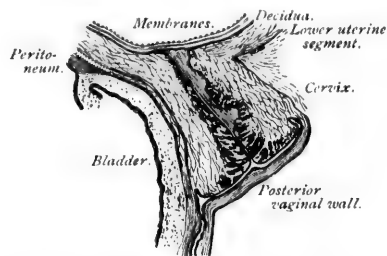


FIG. 168.—Section of cervix at term (Waldeyer). The irregular blotted black marks within the cervical canal, running to the membranes, denote mucous membrane of cervix; the decidua runs in a wavy line beneath the membranes.

when the pelvic floor is endangered. Such assistance to the uterus is not absolutely necessary, for labor may be accomplished in the absence of the action of these external forces, as in paralysis; but when the head lies in the pocket formed by the curve of the sacrum and the partly stretched pelvic floor, having to turn nearly a right angle in its course, the power brought to bear by the abdominal muscles is of very great moment. From the atrophy of the trunk-muscles due

to corset-wearing, failure of force at this crisis often calls for forceps extraction. The uterus is raised by the round ligaments so that abdominal pressure acts to better advantage. The uterus is compressed from all sides, is supported by the pelvic walls, and is arrested in attempts to slip downward by the uterosacral and broad ligaments and the sacral curve, while its contents are pressed out. The increased tension on all the contents of the trunk sends blood to the extremities and flushes the face of the patient. Below the pelvic brim the pressure is not brought to bear, and congestion produces edema and softening of the cervix and pelvic floor. At times the child is expelled with considerable force by means of this added power, and the uterus may even be inverted by these efforts of the external muscular structures.

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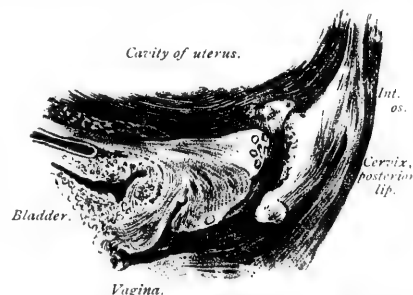


FIG. 169.—Cervix of multipara at beginning of labor; the internal os is at the edge of the crater (frozen section, Winter).

Action of the Vagina.—At first the vagina opposes some obstacle to the advancing head. When, however, a large circumference has passed, any onward motion may receive slight aid from contractions of the vagina. Figure 185 (p. 336) shows how the vaginal walls are smoothly fitted to the child even after the exit of the head has greatly distended the passage.

Changes in the Cervix during Labor.—Although palpation of the external surface of the cervix may give the impression of a smooth expanse of stretched rubber around the opening, yet when the finger is passed within the cervical canal as far as the membranes, is hooked forward, and then slowly withdrawn, one detects two well-defined rings with a 1- to 2-inch (3.5- to 5-centimeter) passage between them, and finds that this passage has yielding side.

walls (Figs. 166, 167, 174). Whether this inner ring be the true internal os, or only the upper limit of the vaginal portion of the cervix, we may be allowed to call it, for clinical purposes, the internal os, since we need to watch its behavior during the dilatation stage.

At the beginning of labor in the primipara the cervix is barely passable by the finger-tip. Dilatation of the internal os occurs first, and it may open rather widely before the external os begins to gape (Fig. 167).

In this case the cervix thins out to a flat ring over the watch-glass membranes, and the external os may form a sharp, parchment-like edge as the internal os merges with the lower uterine segment and the membranes or the presenting part is applied directly to the external os. At other times the two rings draw back in less marked succession (Figs. 169, 170). In multipara the more open canal freely admits the finger during the last month, and the condition is suggestive of labor begun. But an inner edge may usually be distinguished (Fig. 170) until the early labor-pains⁸ or the threatening preliminary pains begin. The effect of such early pains in commencing the dilatation of the cervix in certain cases is

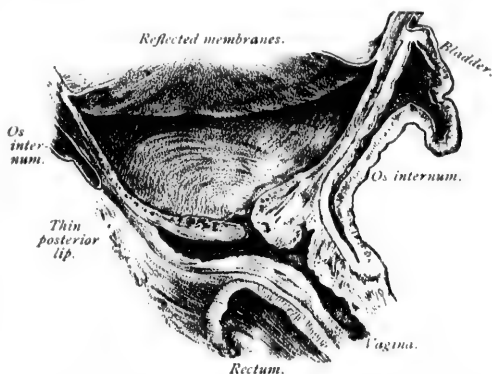


FIG. 170.—Cervix of five and a half months' primipara in dilatation period, with marked irregularity in progress of dilatation of posterior and anterior lips, the posterior being nearly flattened (Winter; frozen section, five-eighths natural size). Compare widening funnel or crater with Figure 169.

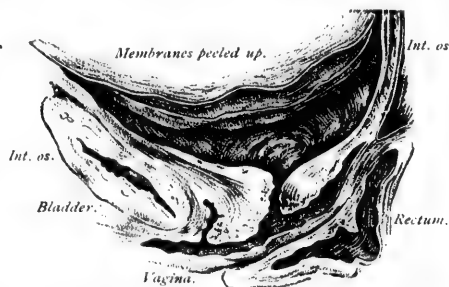


FIG. 171.—Dilating cervix of eight months' primipara, with pronounced thinning of posterior lip (Winter; frozen section, two-thirds natural size).

shown in Figure 175. In multiparæ labor is likely to pull back the whole cervix bodily, but with some thinning and with a somewhat irregular edge. Gradually the circle widens until it merges imperceptibly into the uterine wall, leaving, as a rule, to represent the external os, a slightly raised encircling ring in the wall of the curved birth-tube 3 millimeters ($\frac{1}{8}$ inch) in thickness, located against the back of the symphysis in front and halfway up the sacrum behind (Fig. 134). The wall of the cervix is then 2 millimeters ($\frac{3}{16}$ inch) in thickness, and the cervix is said to be effaced. The anterior lip may be nipped between the bony ring (pelvis) and the ball of bone (fetal head) and become elongated

and edematous, even to the extent of appearing at the vulva during delivery or of hanging without it afterward. In patients with contracted inlets the external os often remains at or near the brim after full dilatation.

The dilatation is estimated either by guessing the coin it seems to resemble in size, or by stating the inches of its diameter, or the number of fingers which the elastic ring will admit. The cervix may not be found greatly dilated, and yet may be dilatable to a large size, as determined by the introduction of four fingers or the whole hand. The common error of the beginner is to

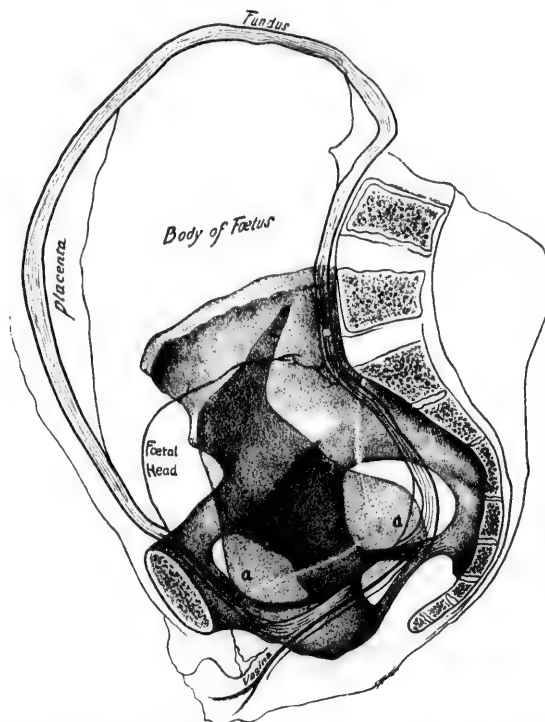


FIG. 172.—Cervix compressed between the head and the pelvic floor, at the beginning of labor in a VI-para (Hart, one-third natural size). The cervix extends from the tuberosity up to the right-hand *a*: the vagina is shown, and also the ureter and the base of the broad ligament; the area on the side not covered with peritoneum being the shaded space (*a, a, a*).

believe that the cervix is much more widely opened than it is in fact. He is sometimes deceived into thinking the cervix has gone by the exceeding thinness of the tissue stretched taut over the head (Figs. 167, 210; p. 385), or, again, by the softness of the yielding edges. The cervix may remain in a stationary and partly dilated condition for hours, or, in rare cases, for days. It may close after partial dilatation—even from the size of three fingers.

The *mechanical* factors effecting dilatation are discussed on pages 424–430. The *active* agents are: (1) Contraction of the longitudinal fibres of the uterine

body, pulling the cervix up over the ovum; (2) hydrostatic pressure of the bag of waters; (3) wedge-action of the presenting part; (4) softening of the cervix.

There is tension on all the other uterine vessels during a contraction, but the unsupported cervical vessels below the pelvic brim become engorged and the lymphatic interspaces are infiltrated with serum and loosened; thereby the force of cohesion is lessened. Were it not so, the elastic cervix would close down on the shoulders after the passage of the head. "Indeed, the conditions of an elastic tube are not infrequently realized in versions where an attempt is made to extract the fetus through an imperfectly dilated os; in which case, after the disengagement of the shoulders, the cervix is apt to close upon the neck and arrest the delivery of the after-coming head. That this complication does not happen as a rule is due to the fact that in natural labors the mechanical expansion is associated with certain organic changes which render the cervix soft and distensible, and which at the same time diminish its retractility."⁹

To bring the cervix to a circle of a diameter of 5 centimeters (2 inches) frequently demands two-thirds of the total time required for full dilatation. Irregular dilatation is not infrequent, wherein the posterior lip is further effaced than the anterior, or inversely, but the former is more common. From the frozen sections, the first process would seem to be constant in occurrence and most marked in character (Fig. 170).

Location of the Orifice.—The internal os is found at the beginning of labor and in frozen sections 6.3 centimeters ($2\frac{1}{2}$ inches) below the brim, being a little lower than in the nullipara.¹⁰ The cervix may be high and pointing backward, and, in practice, when there is much difficulty in reaching it far up toward the promontory, one may be obliged to hook the anterior lip downward with the finger in successive sections until the external os can be caught (Fig. 356, page 556). A cervix at a long distance from the vulva suggests false labor-pains taking place at an early period of pregnancy, before the occurrence of "sinking" of the uterus, or a contracted pelvis. The cervix may be found low in the pelvis, near the vulva, with the head packed into it, pressing it downward against the pelvic floor and toward the vulvar opening (Fig. 172).

Changes in the Lower Uterine Segment.—The two beliefs concerning this portion of the uterus can only be summarized. Schroeder and his school teach that the lower uterine segment is that part of the wall of the body of the uterus (Fig. 173) extending from the *contraction-ring* above—the level at which the peritoneum is found firmly adherent—to the internal os below; that it is constituted of more loosely adherent muscular layers than the wall higher up; and that it is relatively passive during labor. By its anatomical structure and by the epithelial covering of its mucous membrane the lower uterine segment is differentiated from the cervix in both the pregnant and the puerperal uterus. In pregnancy the internal os may be found by its forming the upper end of the closed cervical canal. With this point the denser structure, with its connective-tissue appearance, the character of mucous membrane and its junction with the decidua above, and the upper limit of the arbor vite, usually coincide. The lower segment differs distinctly from the upper, to which it belongs

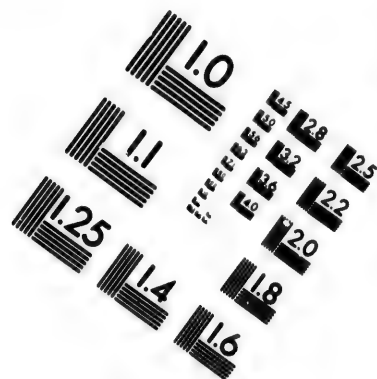
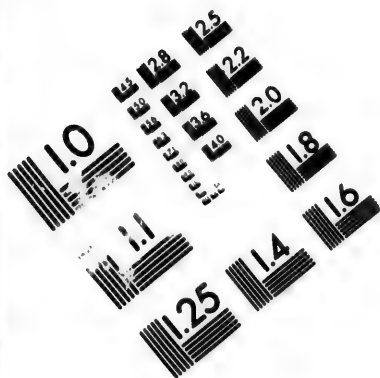
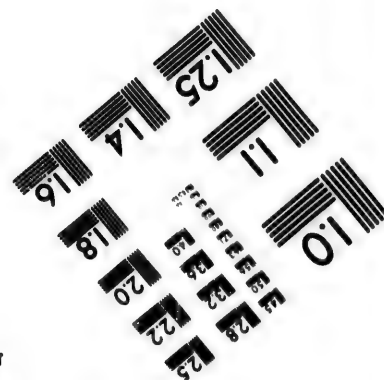
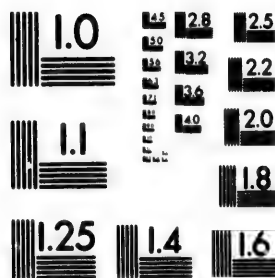


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anatomically, in possessing loosely connected muscular layers which are easily separated, whereas the rest of the body of the uterus is made up of inseparably interlaced bundles which can only be dissected from one another, even in the thinnest layers, by destroying the structure (Hofmeier).¹¹ "The physiological behavior of the lower uterine segment during labor is essentially passive, as opposed to the remaining portion of the uterus, which is sharply contrasted with it by contractions." The difference between the two is palpable, after vigorous uterine contractions, to the hand within the cavity, the ring being occasionally detected by the hand without as well. The term "contraction-ring," though firmly seated, should yield, in the writer's opinion, to the more correct "retraction-ring," which is self-explanatory.

The writer has given precedence to the views of those investigators who believe that the cervix remains unchanged until the beginning of labor. Only

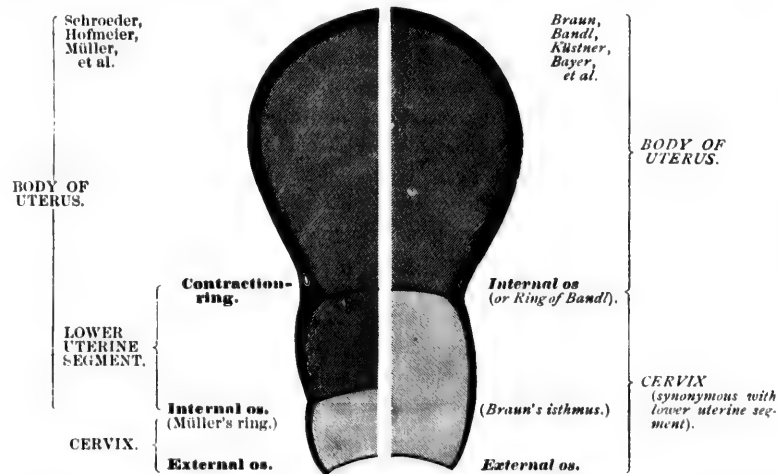


FIG. 173.—Diagram illustrating the two teachings anent the lower uterine segment and the cervix. On the left side an internal os has been added for the sake of clearness, although in the frozen sections of women with full dilatation it is rarely apparent macroscopically (one-third natural size).

the briefest outline, however, of the voluminous controversy¹² can be given, and the opposite side stated. The older theory held that toward the end of pregnancy the upper portion of the cervix was expanded and drawn up to form part of the general uterine cavity, leaving only the small vaginal portion of the cervix below. Braun, whose section is given in Figure 134, believes that the semicircular ledge with the large vein (*Kranzvene*) is the internal os, 10 to 11 centimeters (4 inches) above the external os; Bandl confirms this. He now believes,¹³ with Küstner, that in first labors the mucous membrane of the dilated portion of the cervix—the lower uterine segment—becomes torn or stripped off, and subsequently there is formed upon the denuded surface a new membrane not distinguishable from that of the corpus, which in future pregnancies is capable of forming a decidua. Bayer¹⁴ concludes that "the ex-

cessively thin decidua of the lower uterine segment passes into cervical mucous membrane on the posterior wall of that segment, and that the lower uterine segment and supravaginal cervix are one and the same thing. It envelops the presenting part during labor, it is thinned out, distended, paralyzed, while the thick, contractile muscle-mass of the corpus lies above, where the phenomena of contraction occur with their expulsive effect upon the uterine contents."

Practically, the lower uterine segment interests us as the common seat of rupture of the uterus. During long labors, or where obstruction is associated with vigorous contractions, extreme thinning occurs at this level, and in such cases the retraction-ring can sometimes be felt as a band or ridge in the vicinity of the navel to serve as a danger-signal.

The thickness of the lower uterine segment was measured by the writer on such of the frozen sections as would admit of study. In 5 cases at the eighth and ninth months of pregnancy the average thickness of the wall was 6 millimeters ($\frac{1}{4}$ inch), the extremes being 5 and 10 millimeters ($\frac{3}{16}$ to $\frac{5}{16}$ inch). In 5 cases in the stage of dilatation the average thickness was 3.6 millimeters ($\frac{1}{8}$ inch), the extremes being 2 and 5 millimeters ($\frac{1}{16}$ to $\frac{3}{16}$ inch). In 6 cases in the expulsion stage the average thickness was 3.5 millimeters ($\frac{1}{8}$ inch), the extremes being 2 and 7 millimeters ($\frac{1}{16}$ and $\frac{4}{16}$ inch plus). The remarkable thing in this series is that there are so many instances where a measurement close to 2 millimeters ($\frac{1}{16}$ inch) was found, in some sections of the wall, either in the first or the second stage—namely, in seven different patients. Thus we may say that *before labor the wall of the lower uterine segment is 6 millimeters ($\frac{1}{4}$ inch) thick, and during labor 3.5 millimeters ($\frac{1}{8}$ inch).* Anterior and posterior walls are rarely equal in thickness, but the sections are nearly equally divided on thinner anterior or thinner posterior walls.

Changes in the Body of the Uterus.—Thickening of the wall of the upper uterine segment is a somewhat constant factor. It is especially marked in long or obstructed labors (Figs. 134, 185, 288). The average thickness of the uterine wall at term is the same as during the early dilatation stage, as

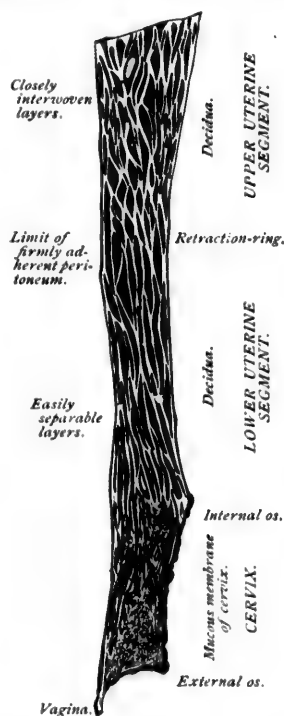


FIG. 174.—Section of the wall of the pregnant uterus (Hofmeier). The difference in texture between cervix and lower uterine segment, according to Hofmeier, is clearly shown, as well as the loose-meshed and close-meshed muscle-layers of the upper and lower uterine segments.

measured on eight frozen sections—namely, 7 millimeters ($\frac{1}{4}$ inch). Toward the close of the expulsion stage it is, on five sections, from 9 to 18 millimeters ($\frac{1}{4}$ to $\frac{3}{8}$ inch), averaging 1 centimeter ($\frac{2}{5}$ inch).



FIG. 175.—Section of primipara of twenty-ninth week, showing beginning dilatation of the cervix in the absence of painful contractions: *mp*, mucous plug; *io*, internal os, with attachment of membranes (Ahlfeld; hardened preparation, one-third natural size).

membranes, and the amount of liquor amnii. It may be (1) Flat; (2) watch-glass—this is usual with vertex presentations (Fig. 176); (3) hemispherical—it may bulge full and round (Fig. 177); (4) glove-finger—it may be elongated



FIG. 176.—Form of membranes during dilatation, watch-glass (Varnier): the presenting part is large and fills the cervix (one-sixth natural size).



FIG. 177.—Form of membranes with less efficient filling of cervix and pelvis, and larger quantity of fore-waters (modified from Varnier).

in shape when the cervix is narrow and the presenting part does not fill it, as in knee or shoulder presentations (Fig. 178); (5) pear-shaped (Fig. 179), as

Bag of Waters — Fore-waters.—Through the dilating cervix the fetal envelopes are felt, growing tense during the pains or just before the sensation of suffering comes. The ovum is being peeled off the lower uterine segment and protruded. We note the amount of tension, the shape of the protruding sac, and its volume, and, later, the location of the tear. The tension is usually intermittent, as above stated. At times we detect a permanent lesion and look out for hydramnion or twins.

The shape of the sac depends on the shape or size of the presenting part, the elasticity of the

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where the fetus is dead and macerated;¹⁵ (6) double, as with twins—but very rarely.

The membranes are slightly permeable under pressure (Tarnier and Pinard), and at times the amnion will leak into the chorion, giving a double pouch. Some of the vaginal flow has been credited to this source.

The cervix and lower uterine segment are drawn up over the protruded ovum. The chorion often separates from the decidua. The attachment of



FIG. 178.—Glove-finger form where the presenting part is small (modified from Varnier).



FIG. 179.—Pear-shaped pouch seen with some cases of macerated fetus (modified from Varnier).

the membranes until the beginning of labor is at the internal os, or upper limit of the apparent cervix. In normal cases¹⁶ the coverings of fetal origin are not separated, maternal and fetal membranes parting at the level of the lower pole. In certain cases before rupture the chorion and amnion may already be separated throughout or far up on the cord.

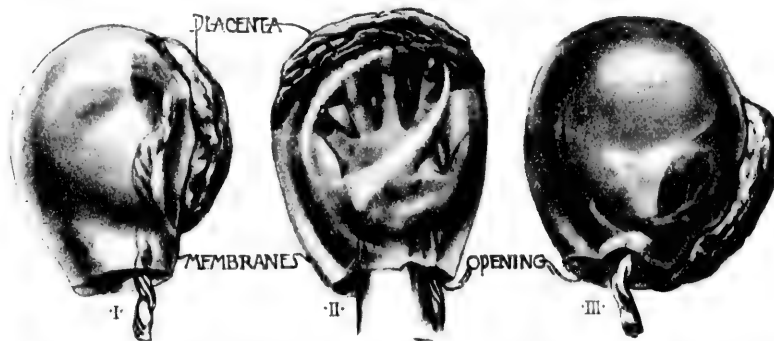


FIG. 180.—Placenta and membranes after delivery, to show how the relation of the opening to the placenta indicates the site of the latter: I., lateral implantation; II., fundal implantation; III., placenta, previa marginalis.

Normally the membranes give way on full dilatation of the cervix when pressing on the pelvic floor. At times rupture occurs days or hours before labor, from low implantation of the placenta.¹⁷ In Pouillet's case the mem-

branes gave way six days, and in that of Matthews Duncan forty-five days, before labor. A copious discharge of fluid that has collected between the ovum and the uterus and due to a catarrhal endometritis, called "*hydrops gravidarum*," may deceive one into believing that the amniotic sac is empty. A more common cause of error is the gushing of odorless hysterical urine. At times rupture is delayed until the membranes bulge through the vulva. In rare instances the child is born enveloped completely in the unbroken sac; this is the "caul."

The chorion usually gives way first, having a firmer attachment, as the amnion can loosen over most of its surface and slip downward and out. The seat of rupture may not correspond with the opening of the cervix. If it is on the side wall, the waters may leak more slowly, but this slow flow of the fore-waters is not very often seen, although discharge of the hind-waters in jets, as the presenting part recedes from its tight fit in the cervix during a contraction, may simulate it. Frequent gushes of so-called "*liquor amnii*" are often only urine. After rupture the waters may come away with a forcible gush or may leak slowly. On examination after delivery the position of

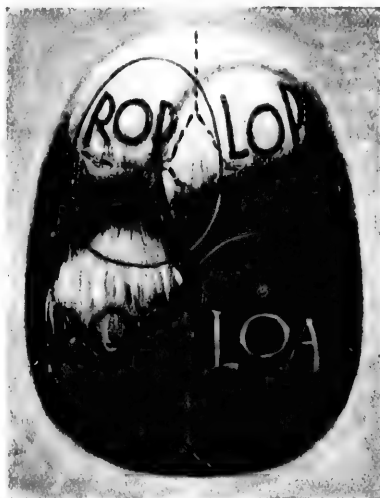


FIG. 181.—Location of the caput succedaneum, and its indication of the original position of a vertex presentation.

the tear in the membranes shows the location of the placenta in the uterus (Fig. 180). An opening opposite the after-birth would denote implantation in the fundus; a tear close to the margin of the placenta would indicate placenta prævia; and one of the intermediate degrees is also shown.

Character of the Liquor Amnii.—Ordinarily the waters have a slightly turbid, yellowish color. At times the amniotic fluid is thick with greenish or brownish meconium, due, perhaps, to undue pressure on the child, and sometimes indicative of danger, except in breech presentations. Flakes of skin

and a muddy consistency suggest a macerated fetus. Bright blood in any quantity within the membranes indicates premature separation of the placenta with leakage into the amniotic sac, but is very rare.

Formation of the Caput Succedaneum.—The caput succedaneum is an edematous swelling that develops on the presenting part of the child as the cervix expands. The cervix makes pressure all over the presenting part during uterine contractions, except at one spot, and here serous infiltration develops a doughy prominence. The size of this swelling varies with the duration of the labor. If it occurs on the face, the grotesque disfigurement alarms the family, but the swelling subsides in a day. The scrotum may assume large dimensions in breech labors. On the scalp the position of the edema serves to indicate the position in which the head enters the pelvis, provided too long delay in the lower birth-canal has not occurred. The tumor is located on that end of the head and that side of the head opposite in name to the position. Thus in the left occipito-anterior position it is found to the right posteriorly; in right occipito-posterior, to the left and front (Fig. 181).

CLINICAL COURSE OF LABOR.

Signs of Beginning Labor.—From eight to fourteen days before labor "sinking" or "lightening" occurs in a considerable number of patients. The uterus drops lower, the fundus falls forward, the head engages or descends to lie on the pelvic floor (Fig. 172), and as a consequence the patient experiences a sense of relief, breathes more freely, digests better, and has looser waistbands. This may never occur in a given patient, or it may happen two days or four weeks before delivery. In half the primigravidae Brühl examined he found the greatest circumference of the head beneath the brim at the end of pregnancy where the inlet was roomy, whereas in only one-third of the multigravidae was this condition seen, owing to the laxer state of the abdominal wall after first pregnancies. On the other hand, irritability of the bladder and venous obstruction in the legs or the labia, with more difficulty in walking, may result from the intrapelvic pressure. At the time of subsidence the intermittent contractions may begin to be painful, so that labor is supposed to be under way, the pains often being grouped in certain parts of the day or night, and being most commonly seen among multiparae. Late in pregnancy the vagina and the vulva are relaxed, a glairy mucus lubricating them and facilitating internal pelvic measurement and examination.

The only certain method of determining whether labor is under way is by digital exploration of the cervix. By passing the finger within the cervix and hooking it forward we may determine whether the internal os is widening or disappearing (Fig. 166), and the whole tubular canal of the cervix is being thinned and drawn up; for we must remember that in over-distention of the uterus, as in cases of hydramnion or twins, or in the relaxed state of some multiparous uteri, or where there has been wide laceration, the cervix gapes in the last month, and that a low position of the fetus flattens the cervix between the head and the pelvic floor (Fig. 172).

We are warned that labor is actually under way by the following signs :

1. Irritability of the bladder and the rectum becoming more marked than before, micturition being particularly affected.
2. The "show"—an escape of blood-streaked mucus, due to slight lacerations of the cervix. This sign is not constant.
3. Expulsion of the mucus plug from the cervix—a sign not often detected.
4. Increased secretion. Both cervical and vaginal mucus is poured out in such a manner that when the passages seem soaked and softened with free mucilaginous discharge we may expect to find cervical dilatation making good progress.
5. Rhythmical uterine pains. The most conclusive symptom of beginning labor is the occurrence of regularly recurring pains, with lessening intervals and increasing force, and the most conclusive sign is that stated above—namely, beginning dilatation of the cervix.

Stages of Labor.—The *first* stage, better called the *dilatation* stage, ends with the complete canalization of the utero-cervical zone. The *second* stage,



FIG. 182.—Pelvic floor before distention (modified from a frozen section by Braun and Zweifel, one-third natural size): the edema and thickening seem excessive, but Webster's measurements show that this floor is rather thinner than the average.

the *stage of expulsion*, ends with the birth of the child. The *third* or *placental stage* ends with complete evacuation and lasting retraction of the uterus.¹⁸

The First Stage, or the Dilatation Stage.—When labor is fairly started the contractions of the uterus assume a certain regularity, characterized by decreas-

ing intervals and by increasing force and painfulness. Occurring at first about every half-hour and only slightly discomforting, with some sense of pressure, the contractions gradually run closer together until, toward the end of dilatation, they give but momentary intervals of relief. The pain is located as a rule in the sacral region, and later extends to the lower abdomen or down the thighs. The patient is restless, standing, sitting, moving, tossing, wringing her hands, seizing on a support, calling for pressure against the sacrum, or begging for relief. Her outcry is involuntary, high-pitched, or apologetic, an impatient protest, or a plaint. She can be persuaded with difficulty that any progress is being made by such colic, seemingly futile. Her cries are not like those of the second stage, which is marked by a transition to the groan or grunt of effort as she closes the glottis and strives to expel the child. The maternal pulse increases in frequency during a uterine contraction, while the fetal pulse is

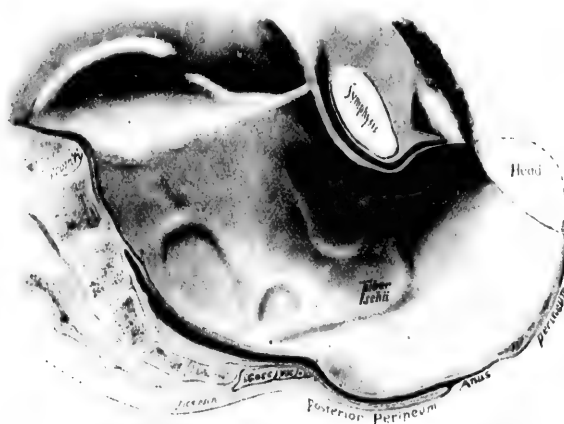


FIG. 183.—Fully-distended pelvic floor (over one-third life size).

retarded at the acme of the pain. The temperature in normal labor rarely rises 1° F. Urine is freely secreted during this stage, and attacks of shivering or vomiting may occur toward its end. With each pain the cervix grows tense, the border becoming sharp and the membranes protruding, to retreat again as the edges relax. Gradually yielding and softening, with abundant mucus-secretion, the retreating edges permit the membranes to rest broadly on the pelvic floor. When the opening measures 7.6 centimeters (3 inches) the bag of waters usually gives way and the "fore-waters" escape, clear or milky, with particles of vernix caseosum, while the bulk of the amniotic fluid is held back by the ball-valve action of the head. After a pause pains recur and the head descends, and the rim of the cervix is pushed back against the pelvic walls until its edges are hardly perceptible, the cervix being flattened against and practically continuous with the vaginal walls.

The duration of the stage of dilatation varies from two hours to several

days. In the primipara twenty-four hours is not uncommon, and the length increases with the patient's age, averaging over thirty hours at forty years (Deeterlin). To give a figure for the student to remember, we say that the average duration in the primipara is fifteen hours, in the multipara eight hours.

The Second Stage, or the Stage of Expulsion.—We are not here concerned with the mechanism, which will be treated later (p. 430). The patient has a fully-dilated cervix, ruptured membranes, and a fetal head resting on the pelvic floor. The character of the pain changes; it is no longer teasing

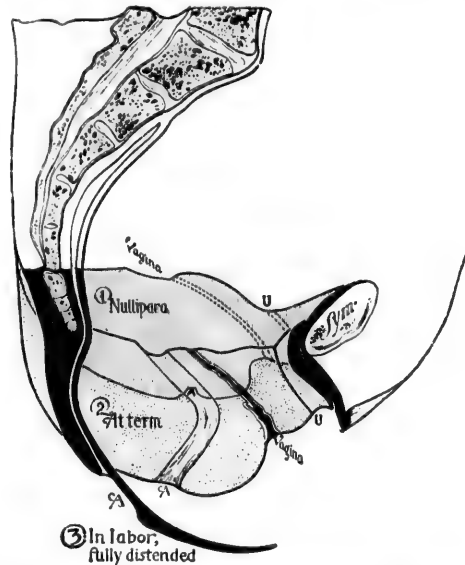


FIG. 184.—Diagram of the pelvic floor before and during the process of thinning or stretching. It will be seen that the structure is thinned rather than driven forward (one-third natural size).

and inefficient; the impulse to drive out the great mass that presses toward the outlet brings about an effort by the diaphragm and abdominal muscles with closed glottis; steadying herself or pulling hard on sheet or assistant, she strains to bring all her strength to bear; instinctively, as in the savage races, she takes the semi-recumbent posture that brings the uterus upright; and her outcry is the groan of great effort or the moan of ended exertion. With each pain the pelvic floor bulges and then recedes; the vulva gapes and the head appears; the parts behind the outlet grow thinner and more dangerously tense; the acme of suffering has arrived. As the head protrudes through the opening the pains grow stormy, and, reckless of injury, the mother drives out the torturing obstruction. The fourchette slips back over the face and is snugly applied to the neck or shoulder (Fig. 185). Now occurs a pause of from one to five minutes. The child may grow dusky, or may attempt to breathe, thus drawing into the air-passages fluids taken into the mouth.

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Usually the next pain expels the trunk, which is followed by a gush of liquor amnii, with some blood. *The duration of the expulsion stage varies from ten minutes to six hours. In primiparæ the average is two hours, in multiparæ one hour.*

Changes in the Pelvic Floor.—The pelvic floor is the fleshy diaphragm dovetailed into the bony outlet of the pelvis. It is about 5 centimeters (2 inches)

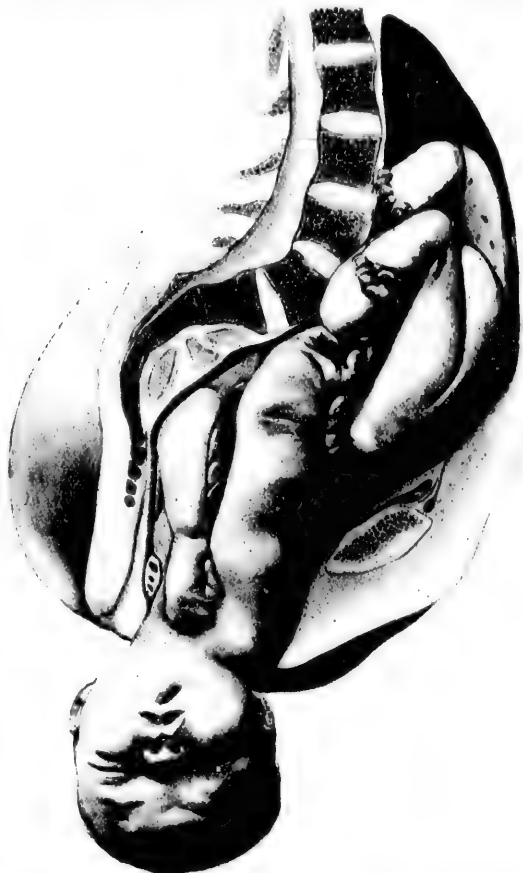


FIG. 185.—Pelvic floor after the escape of the head (one-third natural size): constructed from the Zweifel frozen section to show the pushing forward of the anterior vulvar commissure also, and the remarkable way in which the child is packed into the birth-canal. The passage of this head through the pelvic cavity might well result in rupture of the uterus.

in thickness, concave above and covered with peritoneum, and convex in shape on its lower skin-surface. Between these surfaces lie fasciæ, muscles, connective tissue, and fat, named in the order of their physiological importance. Through the floor run three slits, the urethra, the vagina, and the rectum-anus. The axes of these openings are oblique (Fig. 184), so that direct pressure from above

tends to close the openings by pressing their walls together. Ordinarily their capacity for distention is limited, but the remarkable character of the pelvic floor is that, whereas the chief function of this unique structure is to form a solid and unbroken support for the organs above it under all conditions of strain, at certain moments it must, without injury, efface itself, and open up to the size of its entire length and breadth. We shall consider the changes that bring about this result.

Hart, studying frozen sections mainly,¹⁹ observed that the vaginal slit divides the structure into an anterior part, which he named the *pubic segment*, triangular in shape, composed of retropubic fat, bladder, urethra, and anterior vaginal wall, attached (loosely) to the pubes; and a much larger and stronger posterior part, the *sacral segment*, between the rear vaginal wall and the posterior bony wall, including the anus and part of the rectum. Symington²⁰ considers that the rectum and bladder and the upper vagina, like the uterus, should not be regarded as parts of the floor, but as organs resting upon it. Webster²¹ holds that the bladder is imbedded in the pelvic floor, and that the vagina and cervix are parts of it, together with the rectum from the coccyx down. In the illustration (Fig. 186), for obvious reasons, the bladder and cervix have been omitted.

Late in pregnancy the changes that belong to the pelvic floor are relaxation from edema, moderate increase in thickness, and a low droop or "bulging

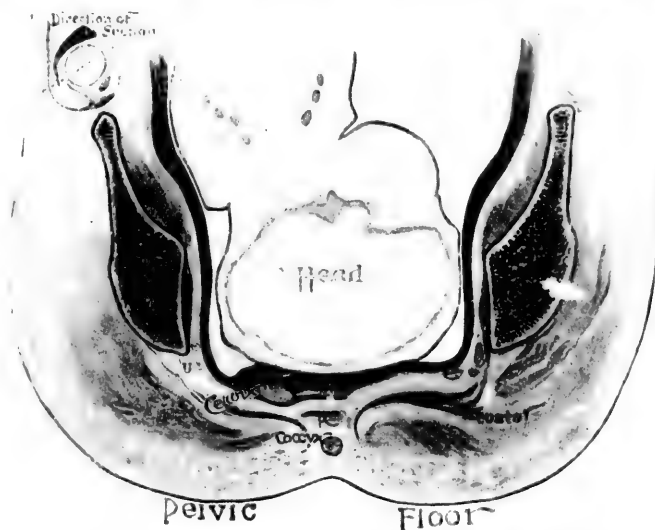


FIG. 186.—Pelvic floor seen in axial coronal section (modified from Hart).

downward." All these changes favor the stretching that is to come. The maintenance of its former axis by the vagina, its distance from the symphysis, the shape of the pelvic floor at this time, and the low position before it is opened up into an oblique hernial canal are shown in Figures 182, 184, and 186.

During labor, in the dilatation stage the parts anterior to the vagina are

restrained from being driven down by the upward traction of the longitudinal fibres of the uterus on the anterior lip of the cervix, to which the bladder is attached. As the os is drawn up the bladder and urethra are somewhat elevated, the former coming to lie at the back and partly above the pubes, flatly compressed against the bone, together with the urethra, by the descending head. The utero-vesical pouch of peritoneum is stripped upward from the bladder (Webster), and the urethra is not elongated.

The parts posterior to the vagina, composing the sacral segment, are of more clinical interest. The change in position here is rather a pushing backward than a driving downward, and is accompanied with excessive thinning. The centre of the perineal skin-surface, and with it the important tendinous centre of the perineum, is only driven down in the long axis of the body 2.5 centimeters (1 inch), while the 5-centimeter (2-inch) perineal pyramid is attenuated to 4 or even to 2 millimeters ($\frac{1}{32}$ or $\frac{2}{32}$ inch).* The sacral segment is moderately elongated. From the tip of the sacrum to the posterior commissure before labor is about 16.6 centimeters ($6\frac{1}{2}$ inches). During full stretching by the head the Varnier section measures 19 centimeters ($7\frac{1}{2}$ inches), and the writer's hospital measurements averaged 18 centimeters ($7\frac{1}{4}$ inches). The sphincter ani gapes a little over an inch (Hart), and assumes the form of a D laid on its side (thus, \ominus), while the anus is displaced backward (Fig. 184, A, A, A). The figures may be summarized as follows:—

	Centimeters.	Inches.
Thickness of the pelvic floor in front of the anus, in nullipara (Webster)	3.3	1 $\frac{1}{4}$
“ “ “ “ at term, before stretching . . . . .	.7	2 $\frac{1}{4}$
“ “ “ “ moderately distended . . . . .	.25	1
“ “ “ “ fully distended . . . . .	.3	$\frac{1}{4}$
Projection of pelvic floor, in nullipara . . . . .	.25	1
“ “ “ “ at term, before stretching . . . . .	.7	2 $\frac{1}{4}$
“ “ “ “ at greatest distention . . . . .	.9	3 $\frac{1}{4}$
“ “ “ “ on twelfth day of puerperium . . . . .	.25	1
Length of perineal body, from fourchette to anus, in nullipara	3.3	1 $\frac{1}{4}$
“ “ “ “ after complete dilatation by the head	6.5	2 $\frac{1}{2}$

The Third Stage of Labor, or the Placental Stage.—The processes whereby the placenta is separated and expelled and retraction of the uterus is secured are given on page 440. Clinically we note that the fundus is hardened by firm uterine contraction, and is located above the brim, but below the level of the navel. Blood trickles in small quantity from the vagina during the pause, the total blood-loss in a labor averaging less than 500 grams (18 ounces). After a rest rhythmic uterine activity is renewed, and the placenta comes away, followed by the membranes, and the corpus is found to have but half the former breadth and to be halfway to the navel. Very moderate stimuli—such as friction, nursing, a douche of hot water—will now produce good contraction, whereas strong excitors may have failed while the uterus was distended.

* The figures used in this discussion are drawn in a certain degree from Webster and Varnier, but are mainly based on an independent study of eighteen frozen sections that range from the eighth month to the middle of the expulsion stage, and are corrected by a number of lead-tape tracings of the pelvic floor during labor.

The average duration of the placental stage is from twenty to thirty minutes. The placenta may follow the child at once, or it may remain two hours. After that time the case belongs under the head of Pathology.

Duration of Labor.—The length of labor varies within very wide limits, and our definite statements of averages do not claim accuracy. The exact hour of the onset of labor is often impossible to fix. Labor is usually longer in the primipara than in the pluripara, on account of the greater resistance of the soft parts during the first delivery. It is longer, as a rule, in the very young and in the elderly primipara, and in the stout than in women of slighter build. Spiegelberg's 506 cases are commonly quoted, wherein the three stages in the primipara are averaged respectively at fifteen hours, two hours, and half an hour, with a total of about seventeen hours, while the multipara is listed at eight, one, and one-half, the total being given as eleven hours. Many of the text-books are non-committal. The majority, however, estimate the duration of labor in the multipara at eight hours—not varying greatly from Spiegelberg's figures in other respects.

Table of Average Duration of Stages of Labor in Hours.

	Dilatation Stage.	Expulsion Stage.	Placental Stage.	Total.
Primipara	15	2	$\frac{1}{2}$	17
Multipara	8	1	$\frac{1}{2}$	9

Spiegelberg²² states that labor most frequently begins between 10 and 12 o'clock in the evening, and the end of labor occurs twice as often between 9 P. M. and 9 A. M. as in the other twelve hours. West²³ found, in 2019 cases, 40 per cent. delivered between 11 P. M. and 7 A. M., and the most favored time is between midnight and three in the morning. A larger number of rapid labors are said to occur in summer than in winter (107 : 100).

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II. THE CONDUCT OF NORMAL LABOR.

1. ANTISEPSIS.

NOWHERE do we find more striking proofs of the value of the antiseptic system than is shown in the diminished puerperal mortality and morbidity in hospitals since the introduction of antiseptics into obstetric practice. Before the advent of Listerism the usual death-rate from childbed fever in lying-in hospitals was from 2 to 10 per cent., and in so-called "epidemics" this limit was often exceeded. In the women who survived, feverless childbeds were comparatively infrequent. Under antiseptic methods the mortality from sepsis in well-managed institutions is less than 1 in 200, and the morbidity does not exceed 10 per cent.

A few examples will suffice to show what is possible under the present perfected system of aseptic obstetrics. Professors Groth, Netzel, and Sonders of Stockholm report¹ 17,862 births under their direction (1880-89), with 1 death in 344, or .29 per cent. In Copenhagen (1888-89), in 1218 hospital deliveries the death-rate was .24 per cent. Slawiansky² tabulates the results of 176,646 deliveries in fifty-three hospitals of Russia (1881-89), showing a morbidity of 8.57 and a mortality of .38 per cent. Leopold³ records 3089 cases (from May, 1885, to May, 1887) without a death from septic infection.

The Boston Lying-in Hospital (1891) recorded 550 deliveries with no death from septic causes. In 1892 there were 515 confinements with but 1 fatal case from septicemia—a mortality of less than 0.1 per cent. for the two years.⁴ In the Sloane Maternity, New York City, there has been thus far but 1 septic death in 3000 deliveries.⁵ In the New York Maternity Hospital 957 women were delivered during the three years ending Oct. 1, 1893, without a death from sepsis.⁶

While in pre-antiseptic times the puerperal mortality was many times greater in public institutions than in private practice, to-day the pauper delivered in a hospital is exposed to less risk than are the well-to-do classes who are confined in their own homes. Insurance reports show that of all deaths in women between the ages of nineteen and twenty-nine more than 18 per cent., and between twenty-nine and thirty-nine years more than 13 per cent., are due to puerperal causes. From 65 to 75 per cent. of puerperal deaths are attributable to sepsis. It is fair to assume that these statistics have to do almost wholly with a class who are delivered outside of hospitals. This indicates a mortality that is truly appalling, especially when one reflects that it falls upon women in the prime

¹ *Verhandlungen des. X. Internationalen Med. Cong.*, B. 111.

² *Ibid.*

³ *Deutsche med. Wochenschrift*, vol. xlii. No. 25.

⁴ Communication to the writer from Dr. Charles M. Green, Sept., 1893.

⁵ Personal letter from Prof. J. W. McLane, Oct., 1893.

⁶ Personal communication from Dr. Robert A. Murray, Oct., 1893.

of life and usefulness, and is the result of a preventable disease. Yet the disastrous effects of puerperal infection are not represented by the mortality alone. Thousands of invalid mothers owe their impaired health to the milder grades of sepsis in childbed. No stronger evidence could be offered than is afforded by the foregoing facts of the need for improvement in the obstetric methods of the general practitioner.

Obstetric antisepsis dates from 1847. To Ignatius P. Semmelweis, a young Hungarian who at that time held the position of assistant in the lying-in department of the Vienna General Hospital, belongs the credit of first demonstrating its efficacy. The obstetric service of the hospital was divided into two sections, in one of which instruction was given to midwives, in the other to medical students. It was with the latter that Semmelweis was connected. The students in this department were at the same time actively engaged in the pursuit of practical anatomy and pathology. The women were delivered by students who for a considerable portion of their time were occupied with the operations of the dead-house and the dissecting-room. They took no precautions to cleanse themselves except to wash their hands with soap and water, and they made examinations *ad libitum*. The death-rate was excessive, reaching nearly 10 per cent. of the women delivered.

Horrified at this frightful mortality, Semmelweis bent his energies to finding the cause. He was struck with the fact that in the midwives' clinic the death-rate was little more than 3 in every 100 women confined. The records showed also that women delivered before admission nearly all escaped. It appeared, too, that prolonged labors in the students' clinic were almost invariably followed by death, while in the midwives' section the length of the labor made little difference in the mortality. During the time that Semmelweis was engaged in his investigations Prof. Kolletschka, one of his associates, lost his life by a dissection-wound. The symptoms of his colleague's illness were entirely similar to those of the fatal malady which was raging in his own wards. Impressed with the identity of the two diseases, it dawned upon him that the cause of the deadly scourge was to be found in the infected hands of the students who attended the labors.

In May, 1847, he established the order that students before taking charge of a labor case should wash their hands in chlorin-water or in a solution of chlorinated lime, and he restricted the number of examinations. The result was an immediate fall in the death-rate. In six months it had dropped from nine or ten to three per hundred, and in the second year of the new régime it did not exceed 1.5 per cent. No proof could be clearer of the correctness of his views, yet they were bitterly opposed by the profession. He struggled in vain for the acceptance of his theories. He was ridiculed and despised, and finally died insane, the victim of continued persecution.¹

Soon after its introduction into surgery by Sir Joseph Lister in 1866 antisepsis began to gain a permanent foothold in obstetrics. First adopted in

¹ For many of these facts the writer is indebted to an address by C. T. Cullingworth, M. D., F. R. C. P., entitled *Puerperal Fever a Preventable Disease*.

1870 by Stadfeldt of Copenhagen, it was taken up by the principal maternities of Europe, and to-day, with many improvements in the technique, it is universally practised in the lying-in hospitals of the world.

PRACTICAL RULES FOR DISINFECTION.

Instruments, Utensils, and Dressings.—The most efficient of all germicidal agents is heat. For instruments, utensils, sutures, and dressings that will not be injured by high temperatures heat affords the best means of disinfection. Either of three methods, dry heat, boiling, or steaming, may be employed.

Dry Heat.—For metallic instruments and for most utensils exposure in an oven is a convenient and effective method of sterilizing. It is necessary, on the one hand, to make sure that the temperature reaches at least 234° F., and, on the other hand, that it does not exceed 400° F., at which point the temper of steel instruments would begin to suffer impairment. For greater accuracy in regulating the temperature a thermometer specially made for the purpose may be used. As some time will be required to bring the instruments to the necessary degree of heat, the exposure should be maintained for at least fifteen minutes to ensure proper sterilization.

Boiling.—A ready means of sterilizing most instruments is by boiling them half an hour in water. The addition of 1.5 per cent. of washing soda to the water helps to remove greasy matter and prevents steel instruments from rusting. The soda should, if possible, be chemically pure. This method has the advantage that it is available in any household. All that is needed is a vessel large enough to hold the necessary instruments and appliances and a range fire, gas stove, or even a large alcohol lamp. In emergency no more elaborate apparatus is required than a common dish-pan. Place in it the instruments, silk sutures, sponge compresses, and other materials to be sterilized, cover them with water, and boil for the requisite length of time. Turn off the water, and the pan serves as an aseptic instrument-tray.

Steaming.—Sterilization by steam requires special apparatus. Numerous appliances are to be had for the purpose, one of the most economical of which is the Arnold steam-cooker. This process is available for practically all instruments, dressings, and utensils not too bulky to be contained in the sterilizer. It is well to place the articles to be sterilized in a wire basket or a cloth bag in which they may be lowered into the steam-chamber. This facilitates handling and makes it possible to remove the instruments promptly on opening the sterilizer. If allowed to remain in the steam-chamber for even a few seconds after air is admitted, the instruments become wet with condensed steam and polished steel surfaces are liable to tarnish. The time required for sterilization is from thirty minutes to an hour, according to the bulk and character of the materials. Dressings need the longest exposure.

In the labor ward of a hospital a steam-sterilizer may be kept in operation during the labor, and the instruments, compresses, sutures, and dressings may be taken direct from the steam-chamber as they are wanted for use.

Chemical Antiseptics.—Among the chemical agents most commonly em-

ployed for obstetric antiseptics are the mercuric chlorid dissolved in water, in strength of from 1 : 2000 to 1 : 500, the mercuric iodid in similar proportion, the peroxid of hydrogen¹ (15-volume solution), the liquor sodæ chlorinatæ diluted with 9 volumes of water, a 2 per cent. creolin mixture (in water), a 2 to 5 per cent. solution of carbolic acid, and a 1 : 1000 solution of hydro-naphthol. The order in which they are named is substantially that of their germicidal potency.

The practical efficiency of mercuric chlorid (corrosive sublimate) is greatly increased by the addition to the solution of five parts of hydrochloric, tartaric, or acetic acid for each part of the sublimate, since in neutral solutions of that salt the mercury is precipitated as an albuminate on contact with blood or with other albuminous liquids. The acid, moreover, serves to protect the solution against impairment of strength by contact with the alkaline fluids of the tissues. The mercuric chlorid is decomposed by alkalies. The mercuric iodid (biniodid of mercury), requires the addition of an equal weight of the iodid of potassium to render it freely soluble. With this salt no acid is required. Neutral solutions of the mercuric iodid yield no precipitate with albumin. The chlorinated-soda solution, the peroxid of hydrogen, and the creolin mixture have the advantage of being practically non-poisonous, and they are therefore more suitable to be trusted to the nurse than the mercurial preparations.

The Obstetrician.—The obstetrician should always be clean; especially must his hands be clean, and he should wear clean clothing. It is well to avoid contact with pathological material and, so far as possible, with other sources of wound-infection. Yet attendance on post-mortems and contagious diseases is not necessarily inconsistent with the safe conduct of confinements, provided a rigorous antiseptic cleansing be always observed as a preliminary to the care of the obstetric patient. After a septic exposure an entire change of clothing and repeated and conscientious use of disinfectants must be practised before taking charge of a case. The writer has repeatedly attended a prolonged labor, has delivered by forceps, and has repaired perineal ruptures within one or two hours after having the hands bathed in offensive pus, without infecting the patient. Repeated scrubblings with hot water and soap and with disinfectants, including the final use of the permanganate method, will, if properly executed, ensure complete asepsis of the hands within an hour after the worst exposure.

When summoned to a case of labor immediately after a septic contact, besides the usual care in disinfection, in simple labor all internal examinations may be avoided. In addition to this, it is possible, if thought necessary, to manage the birth even without contact with the external genitals of the patient, the required manipulations being conducted through the intervention of a fresh towel well saturated with the antiseptic solution.

It is impossible, however, to lay down rules which alone will make an aseptic practitioner. The obstetrician must be possessed of an aseptic instinct,

¹ The best preparation of the peroxid of hydrogen is pyrozone.

and this is a matter which comes of training and a keen appreciation of the possible sources and modes of infection.

In hospital practice the obstetrician should, during attendance upon a labor, wear a fresh-laundered gown or a clean apron large enough to prevent contact of his hands with his clothing. His hands and forearms are to be cleansed thoroughly and disinfected before the first examination, and before each subsequent contact with the genitals if they have in the mean time touched anything that is not aseptic.

For the disinfection of the hands the following method, which is substantially that of Fürbringer, is recommended :

1. Clean the nails dry.
2. Scrub the hands and forearms for not less than three minutes with a hand-brush, with soap and water as hot as can be borne. Special care must be taken in brushing the nails and finger-tips, and the water should be changed two or three times.
3. Soak well with alcohol (not below 80 per cent.) and, before it evaporates,
4. Immerse for three minutes in a hot solution of mercuric iodid or chlorid (1 : 2000 to 1 : 500), or in a 3 per cent. solution of carbolic acid.

Undoubtedly, the most essential step in the process is the soap-and-water scrubbing. It not only removes the greater part of the offending material, but it is also indispensable to the proper action of the antiseptic solution. The latter can penetrate the skin only after the oily matter has been removed and after the skin is thoroughly wet. The use of alcohol helps the action of the chemical solution by dehydrating the skin and rendering it hygroscopic, thus favoring penetration of the solution.

Welch, of the Johns Hopkins Hospital at Baltimore, recommends the following procedure, which is known as the *permanganate* method. By it the hands, it is claimed, may be rendered practically sterile to culture tests :

1. The nails are cut short and carefully cleaned.
2. The hands and forearms are scrubbed for three minutes with soap and water. The brush before using is sterilized by steam, and the water, which is as hot as can be borne, is frequently changed. The soap is rinsed off with plain water.
3. The hands are next immersed in a warm solution of permanganate of potassium and are scrubbed with a sterilized swab. Distilled, or at least boiled, water should be used for the solution, which should be saturated.
4. The hands are next held in a warm saturated solution of oxalic acid in boiled water until the permanganate stain is entirely discharged.
5. After rinsing in sterilized water the hands are immersed for two minutes in a 1 : 500 mercuric-chlorid solution.

The Nurse.—The nurse should be no less careful than the obstetrician in the observance of all antiseptic details.

The Patient.—In hospital practice the patient has a bath and a change of clothing at the onset of labor. Before the first internal examination the abdomen, the thighs, and the vulva are cleansed by the nurse with soap and

warm water. The soapy water is rinsed off and the parts are well bathed with the antiseptic solution. It is a useful precaution to cover the limbs of the patient, when she takes the bed, with a pair of muslin leggings fresh from the sterilizer. The leggings should be closed below, so as completely to envelop the feet. In addition to this, the patient and the entire cot may be covered with a sterilized gauze sheet. During the first stage a vulvar dressing saturated with Thiersch's solution may be worn.

Similar precautions are not all practicable in private practice, nor are they all necessary. The change of clothing, the preliminary cleansing and disinfection of the external genitals and adjacent surfaces, and the aseptic cleanliness of everything that comes in contact with the birth-canal must always be insisted upon.

The utility of prophylactic vaginal douches is a question which has provoked much discussion. Steffek¹ recommends vaginal irrigation during labor with mercuric-chlorid solution at intervals of two hours, rubbing the antiseptic well into the mucous membrane with the fingers.

Döderlein² advises scrubbing the vagina with a preparation of creolin and molin, followed by a ten-minutes' douching with the creolin solution.

Hofmeier³ favors preliminary disinfection, especially in maternity hospitals where students are allowed to examine the patients during labor. He concludes, from a comparison of the records of the Würzburg clinic with the published statistics of other like institutions, that, with preliminary disinfection and the careful observation of all possible antiseptic precautions, instruction by means of examinations during labor does not necessarily increase the danger of infecting the patient. He further contends that thorough disinfection of the birth-canal is not a source of danger to the mother, as has been claimed, but that it results in a diminished puerperal morbidity and mortality.

Frommel⁴ reports over five hundred cases in which vaginal injections of the corrosive-sublimate solution (1:2000) were employed, and where in many abnormal cases from sixty to seventy examinations were made during the patient's stay in the hospital, the clinic being open to about one hundred students, and being also used for the training of midwives. In this number of patients there were two cases of sepsis whose infection was traceable to his clinic. The morbidity-rate was from 5.5 to 7.5 per cent. In another series of cases, where external disinfection alone was practised, the morbidity rose to 11.1 per cent.

Mermann⁵ reports the results of seven hundred cases without the employment of vaginal douches for preliminary disinfection. He records a morbidity-rate of 6 per cent., with no deaths from septic infection. In the last two hundred births there were two cases of mild ophthalmia, and in all less than ten

¹ "Ueber Disinfection des Weiblichen Genital Canals," *Zeitschrift für Geburtshilfe*, vol. xv. p. 395.

² "Disinfection des Geburts-Canal," *Archiv für Gynäkologie*, vol. xxxiv. 111.

³ *Deutsche med. Wochenschrift*, 1891, No. 49.

⁴ *Ibid.*, 1892, No. 10.

⁵ *Centralblatt für Gynäkologie*, 1892, No. 99.

of conjunctivitis among the children. Mermann omits internal examinations whenever practicable, observing the progress of the labor by abdominal palpation and auscultation.

Leopold and Goldberg¹ publish the statistics of several thousand deliveries with and without the employment of vaginal disinfection. Their tables show the best results where the vaginal douches were not used. They recommend the employment of abdominal palpation as a means of noting the progress of labor, and the restriction of vaginal examinations to cases of dystocia, except when necessary to confirm a diagnosis made by the abdominal method. They advise douches in operative cases and in all others where previous infection is suspected.

Fischel in an experience of 880 births at the Prague Maternity lost nine women from sepsis with the employment of preliminary disinfection. After stopping the use of the irrigations, in a series of 933 cases there were but two deaths due to infection, and a year later, in 521 women delivered, there were no deaths from that cause.

The safer course, at least for general use, is undoubtedly the restriction of internal examinations as much as practicable, and of the preliminary vaginal douche to cases in which the secretions are pathological. In the presence of purulent gonorrheal discharges both the vaginal and cervical canal, as well as the vulva, ought to be cleansed carefully with soap and water and gentle friction with the fingers, and subsequently washed well with the antiseptic solution. In extreme cases the disinfection may be repeated at intervals of two or three hours during the labor. This is required not only in the interests of asepsis for the mother, but as a prophylactic against ophthalmia in the child. Mercurials, however, are not suitable for the purpose, owing to the danger of mercurial intoxication. Mercury has been found in the stools after a single vaginal irrigation. Some of the non-toxic disinfectants, such as creolin, peroxid of hydrogen, or the chlorinated-soda solution, are to be recommended.

Döderlein has called attention to the litmus-reaction as a ready means of distinguishing healthy from morbid vaginal secretions. He points out that while in health they are strongly acid, in pathological conditions of the secretions their reaction is feebly acid, neutral, or alkaline. These observations have been confirmed by Williams of Baltimore. The litmus-reaction of the vaginal secretions therefore affords a convenient guide to the conditions in which preliminary internal disinfection is indicated.

Antisepsis in the Use of the Catheter.—Should the patient require to be catheterized after labor, care will obviously be needed to prevent infection of the vaginal wounds and abrasions. But this is not all. Cystitis of the vesical neck frequently results from infectious material carried into the bladder during the use of the catheter. So common is this accident that patients who have repeatedly been catheterized by the nurse, even with ordinary precautions, very rarely escape some degree of vesical irritation, and they often suffer from severe inflammation of the bladder or of the vesical neck. Pyelitis may even

¹ *Deutsche med. Wochenschrift*, 1892, No. 13.

result by extension of the septic process from the vesical mucosa through the ureters. The strictest asepsis must therefore be observed in catheterizing the bladder. The instrument should be boiled in water for fifteen minutes immediately before using, and this is possible even with soft-rubber catheters without material injury to the instrument. It should then be handled only with hands that have been previously sterilized.

The patient lies upon the back with the knees drawn apart. The labia are to be held apart, either by the patient herself or by an assistant, so as to completely expose the meatus urethrae, and so held until the instrument is passed. The meatus, the vestibule, and all the surrounding surfaces are to be cleansed with soap and water, and subsequently be washed with the disinfectant solution. The catheter, well lubricated with sterilized vaselin, is then passed with clean hands and with the parts fully exposed to the eye.

Precautions must be used to prevent urine from trickling over the wounded surfaces or into the vagina as the instrument is withdrawn. The catheter, after using, should be cleansed carefully with water. Care must be taken that irritating chemical antiseptics are not carried into the urethra upon the catheter; otherwise a troublesome urethritis may result.

2. MANAGEMENT OF NORMAL LABOR.

Essential to the proper management of childbirth is a watchful supervision of the health and habits of the patient throughout pregnancy, and a previous knowledge, so far as possible, of the conditions to be dealt with in each case during labor. Next to Listerian cleanliness, nothing is destined to do more for improved results in obstetrics than the practice, now happily growing with obstetricians, of studying their cases before labor.

It is desirable, therefore, that the pregnant woman be under the observation of her physician from an early period of gestation, and especially if the experience be her first. Much-needed information and advice may be imparted with reference to the hygienic requirements of pregnancy. Knowledge may be gained of conditions likely to complicate the parturient or puerperal process, and much may often be done to fortify the health and strength of the patient.

Dystocia, if it cannot be prevented, is more successfully managed with the aid derived from previous knowledge and preparation. Even when all is normal, both patient and physician are amply repaid for their pains by the increased confidence with which the result of labor is awaited.

The patient should be advised with reference to the selection of her nurse. Instructions will be needed pertaining to the care of the nipples. She should be directed to cleanse them daily during the last month or two of pregnancy, and, if they are very small or sunken, to draw them out with the fingers. This manipulation also helps to inure them to nursing. Daily inunction of vaselin or of fresh cocoa-butter during the same period keeps them supple, and is a better preparation for suckling than the use of astringents so commonly practised.

Especially important is it that the functions of the kidneys be watched. During the last one or two months before labor the urine should be examined weekly. An occasional examination at an earlier period is generally advisable. If albumin be found, the microscopic study of the urine will best reveal the character and extent of the structural changes in the kidneys. In doubtful cases the best evidence of the manner in which these organs are performing their functions is afforded by occasional quantitative tests for urea.

OBSTETRICAL EXAMINATION.

In the later months it is the duty of the physician to make a preliminary obstetric examination. The most suitable time is usually about the end of the eighth month. The object is to determine the position and presentation of the child, the relative size of head and pelvis, and the possible presence of pathological conditions that may complicate the mechanism of labor. It is to be assumed that full information has already been obtained, at the time of engaging to attend the patient in confinement, with reference to her obstetric history, including the number of previous pregnancies, term labors, and miscarriages, all important facts pertaining to the character of the pregnancies, labors, and childbed periods, and particulars relating to the course of the present pregnancy.

In hospitals it is the rule to make an external and an internal examination. In private practice an internal examination, while always desirable, need not in all cases be insisted upon. Usually all that is necessary to know may be determined by the external methods. In the presence of pelvic deformity, and in all cases in which for any reason the external examination is not satisfactory, exploration of the pelvic cavity should not be omitted.

It is essential that the bladder and the rectum be empty. The patient lies upon a bed or a lounge, covered with a sheet and with the limbs outstretched. Her clothing is to be loosened and the skirts drawn above the abdomen. The necessary manipulations are conducted under the sheet or through it, without exposure of the patient. In this manner the abdominal examination and the external measurements of the pelvis may be made without causing discomfort or giving offense.

The hands of the examiner are first bathed in warm water to render the skin soft and the touch more acute. This precaution, too, helps to prevent reflex contractions of the abdominal and the uterine muscles, which are more liable to occur when the hands are applied cold to the abdomen.

The examination should be methodical. Errors of diagnosis are more frequently the result of carelessness than of ignorance. Success here, as in most other undertakings, depends upon a capacity for taking pains. All manipulations are to be conducted gently, and need never cause the slightest pain, except rarely when deep pressure is required to map out the lower fetal pole. A definite order of procedure is recommended in accordance with the following scheme :

1. DIAGNOSIS OF THE FETAL PRESENTATION AND POSITION.

Location of the Dorsal Plane and Small Parts.—The situation of the dorsal plane and small parts of the fetus may, as a rule, easily be made out by palpating the abdomen. The palmar surfaces of the finger-tips are applied with light intermitting touches (Fig. 187). Beginning at the lower part of the abdomen, a narrow zone is palpated entirely across from one side of the tumor to the other. The palpation is repeated over a similar area just above the first, and so on until the entire surface of the tumor has been explored. The situation of the fetus will usually be learned by the first touches. It presents to the examining fingers the feel of a solid body, while elsewhere over the tumor only fluid is felt.

The location of the child may more readily be made out by placing one hand flat upon the middle section of the abdomen and pressing firmly backward (Fig. 188). The liquor amnii is thus displaced to one side and the child to the other, where it can more easily be palpated.



FIG. 187.—General palpation of abdomen for locating dorsal plane and small parts of fetus (from a photograph).

The child's back is identified by the length and breadth of the resisting plane which is offered to the examining touch, and by the absence of a sulcus between it and the fetal head. The side of the child presents a narrower



EXAMINATION BEFORE LABOR: Examination of lower fetal pole (from a photograph).

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plane than the back, and a distinct sulcus separates it from the head. The examination of the dorsum is facilitated by applying one hand over the upper fetal pole and pressing downward in the axis of the uterus. The back of the child is thus rendered more convex, and is thrust outward toward the abdominal wall within easier reach of the examining hand.

The small parts are usually felt as nodules which glide about under the touch: they are best identified by circular, rubbing motions; sometimes a fetal member may be mapped out through its whole extent. Except in the case of twins, where there are usually arms and legs in various directions, finding the small parts in one section of the abdomen confirms the location of the dorsal plane in the opposite region. Thus, small parts on the right indicate a left dorsal position, and conversely. Small parts few and hard to find point to an



FIG. 188.—Depressing abdominal walls in locating dorsal plane of fetus in abdominal examination; displacing child to that side of the uterus toward which its back lies, liquor amnii to the other side (from a photograph).

anterior position of the child's back; small parts numerous and found near the middle section of the abdomen usually mean a dorso-posterior position of the child.

Examination of the Lower Fetal Pole.—Facing the mother's feet, place the hands flat upon the abdomen over the lower segment of the uterus (Pl. 23).

With the hands resting upon the sides of the tumor, their palmar

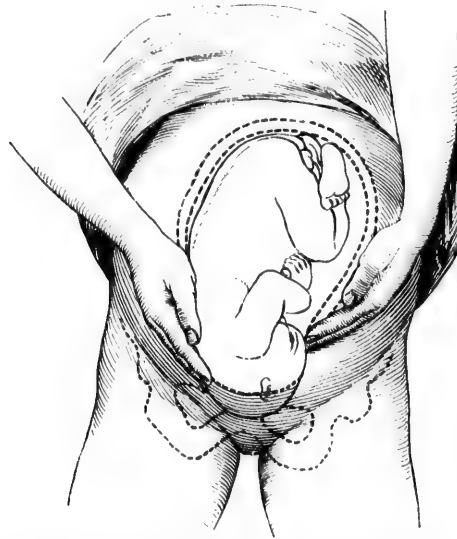


FIG. 189.—Locating cephalic prominence by palpation with both hands. The hand sinks deeper in the pelvis at the side on which the occiput lies (Leopold).

surfaces nearly facing each other and the finger-tips 1 or 2 inches above

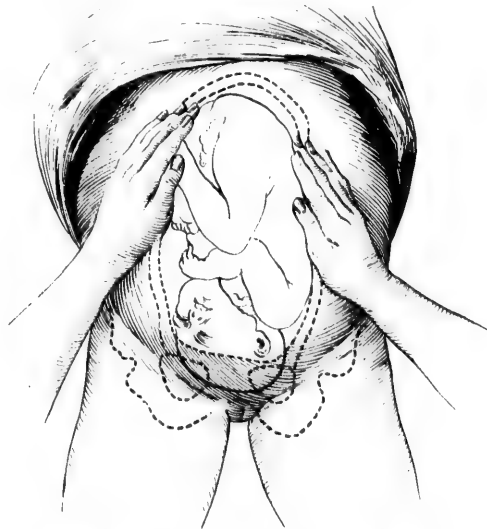


FIG. 190.—Examination of upper fetal pole, showing relation of examining hands to fetal parts (Leopold)

the level of the pubes, maintaining firm pressure, the finger-tips are gently



EXAMINATION BEFORE LABOR: Locating the cephalic prominence (1) - arching the hand across the supra-pubic region (from a photograph).

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thrust downward into the brim of the pelvis. The pelvic excavation is then explored to learn if it contains the presenting fetal part. If it is filled before labor, the presenting part is the vertex. No other fetal part sinks into the lesser pelvis until labor begins, and even this sinking very rarely occurs except in primiparæ. In the latter the fetal head is normally always in the pelvic brim. During labor either pole, whether the woman has previously borne children or not, should be found in the lesser pelvis.

The head when it lies above the lesser pelvis is not usually so accessible to palpation as when in the excavation. A useful manœuvre for locating the head, if it is not readily found by direct palpation, is to place the hands in the usual position over the sides of the lower uterine segment and proceed as for external ballottement, bringing the hands more and more nearly together until the head is found. The head will be recognized as a solid globular body which can be tossed from one hand to the other.

The cephalic extremity is distinguished from the breech by its greater mobility when it lies above the excavation, by its hardness and globular shape, and by the presence of a sulcus between it and the fetal trunk. The breech alone, is smaller, with the inferior extremities larger than the head. It lacks the hard and globular character of the head, and presents no sulcus between itself and the trunk. An imperfect ballottement of the head is frequently obtainable when it lies in the lower segment of the uterus above the pelvic inlet.

Cephalic Prominence.—When the head is in the excavation one side of the brim will be found more completely filled than the other (Fig. 189). This is due to the fact that the occiput sinks deeper into the pelvic cavity than the sinciput. On one side the frontal portion of the head, on the other side the nape of the neck, occupies the pelvic brim. That side of the cephalic tumor which is the more prominent, therefore, is the sinciput. Cephalic prominence to the right indicates a left, to the left indicates a right, fetal position. The situation of the greater prominence will be observed in the course of the palpation above described. It may also be made out by arching the hand across the abdomen immediately above the pubes (Pl. 24; Fig. 193). The cephalic prominence will be found most marked in occipito-posterior positions.

Location of the Anterior Shoulder in Vertex Presentation.—The anterior shoulder may usually be found as follows: While the hands are still held upon the abdomen over the sides of the fetal head, move them upward toward the fundus without relaxing the pressure. The first obstacle they encounter is the anterior shoulder, which may more fully be identified by mapping it out with the fingers of one hand. Steadying the fetal mass by gentle pressure with the other hand over the breech facilitates the examination. Finding the anterior shoulder within 1 or 2 inches of the median line indicates an anterior, and several inches from the median line a posterior, position of the fetus. In left positions the shoulder lies to the left, in right positions to the right, of the median line (Fig. 192).

Examination of the Upper Fetal Pole.—The examiner next faces the mother's face and places his hands over the sides of the fundus (Figs. 190, 191). The fundal pole of the fetus is then examined by palpation. The head is differentiated from the breech by the characters already



FIG. 191.—Examination of upper fetal pole (from a photograph).

mentioned and by a more pronounced ballottement than is usually possible when the head presents. By reason of its smooth, globular shape, and especially of its flexible attachment to the trunk, the head is very movable, rebounding distinctly under the touch when in the roomy upper uterine segment.

Location of the Fetal Heart-tones.—The stethoscope may or may not be used, according to the usual habit of the examiner. The point at which to listen first is directly over the supposed location of the upper part of the child's back. Failing here, the entire surface of the tumor may be searched.

The heart-sounds are usually heard over an area of about 3 inches in diameter, but, since they are sometimes more widely diffused, it is important to locate the point of greatest intensity. The point upon the abdomen at which they are most intense is termed the *focus of auscultation*. As a rule, this point overlies the fetal heart. Exceptionally, the sounds are most dis-

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tingly heard at some remote point, owing to firmer contact of the fetus with



FIG. 192.—Mapping out the anterior shoulder (from a photograph).

the uterine wall at that point. Their location usually serves to distinguish left from right, and anterior from posterior, positions. In a posterior posi-



FIG. 193.—Method of locating the cephalic prominence by arching the hand across the suprapubic region.

tion the heart, if heard at all, is found far back over one side of the abdomen: frequently the cardiac sounds are quite indistinct; rarely they are wholly inaudible.

For the diagnosis of presentation the situation of the fetal heart is of limited value in women who have borne children. Since the position of the heart is nearly midway between the extremities of the fetal ovoid, the mere inversion of the long axis of the child makes little difference in the location of the heart-sounds. In primiparæ, in whom the presenting pole sinks into the excavation in vertex, and rides above it in breech, presentation, the level at which the heart-tones are heard is of some value in determining the presentation. In first pregnancies this level will usually be found below the umbilicus in cephalic, and above it in breech, presentation.

The Location of the Fetal Movements must be taken on the statement of the mother, which statement as an aid to diagnosis is liable to the usual fallacies of subjective signs. It may have some weight, however, in deciding in what part of the uterus the feet lie.

Importance of the Abdominal Examination for the Diagnosis of the Fetal Presentation and Position.—With all the facts clearly made out it will readily be seen that the abdominal examination is of more value for the diagnosis of presentation and position of the fetus than the vaginal touch. Every physician, therefore, should familiarize himself with the technique of abdominal palpation and auscultation in its application to obstetric practice. It is within the power of every obstetrician to become expert in obstetric diagnosis by the abdomen. While the facilities afforded by a hospital service are of great advantage, they are by no means indispensable if proper use be made of the opportunities which even the general practitioner has at his command.

Pathological Conditions.

After determining the presentation and position of the fetus, the abdomen is next to be interrogated for the possible existence of fetal or maternal anomalies that may complicate the labor.

A pendulous abdomen in a first pregnancy should suggest the possibility of pelvic deformity. It not infrequently occurs, however, in multiparæ in whom the pelvis is normal, and it may retard the labor by hindering the engagement of the presenting pole.

Hydramnion is recognized by the increased size and permanent tension of the uterine tumor, by preternatural mobility of the fetus, and by the presence usually of suprapubic edema.

The entire abdomen is explored for the possible presence of pathological growths of the pelvic or abdominal organs.

The location of the placenta may usually be made out by palpation over the abdomen, except when its implantation is mainly upon the posterior wall of the uterus. Its convex edge presents a resisting ring, and the palpation of fetal parts is partially obscured within the placental area. The diagnosis of vicious insertion of the placenta is therefore sometimes possible by abdominal examination.

A hydrocephalic head of a size sufficient to give rise to difficulty in delivery ought to be recognized by external palpation. Its size may be determined

more accurately by measurements taken with calipers through the abdominal walls, and by trying whether it can be crowded into the excavation.

In twin pregnancies, as in hydramnion, the abdominal tumor is usually large and persistently tense, and there is suprapubic edema. Indeed, multiple pregnancies are generally associated with excess of liquor amnii. Single feta-



FIG. 194.—Relative location of the posterior superior iliac spines and spine of last lumbar vertebra. The latter is the second vertebral above the level of the iliac spines (after the Ariadne).

tion with hydramnion is distinguished from plural pregnancy by the greater mobility of the fetus in the former. There is a larger number of small parts than in single fetation, and they are more widely distributed. Two dorsal planes and more than two fetal poles may sometimes be made out. One head in the excavation and one in the upper uterine segment or in one iliac fossa make the diagnosis of twins. Two fetal poles more than 12 inches apart cannot belong to the same child. The most conclusive evidence of double fetation is the detection at the same time of two fetal heart-beats of different rates.

Palpation in multiple pregnancy is generally rendered difficult by the permanent tension of the uterine tumor.

2. EXTERNAL MEASUREMENTS OF THE PELVIS.

In primiparæ, and in multiparæ in whom the previous obstetric history gives rise to any suspicion of pelvic contraction, the external diameters of the pelvis should be measured. Three measurements are usually sufficient—namely, the external conjugate, the interspinal, and the intercrystal.

Of these measurements the most important is the external conjugate (Pl. 25). This diameter is measured from the depression (Fig. 194) just below the spine of the last lumbar vertebra to a point on the pubic surface in front of the upper part of the symphysis. As a rule, it may safely be assumed that the pelvis is ample when this diameter exceeds $7\frac{1}{4}$ inches (18 centimeters),

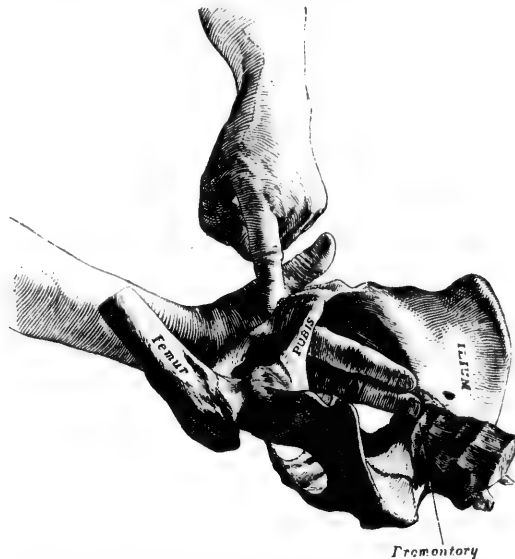


FIG. 195.—Manual method of measuring the diagonal conjugate.

and that it is contracted at the brim when the diameter falls below that limit. Occasionally the sacro-pubic diameter at the brim will be found shortened with an external conjugate of $7\frac{1}{2}$ inches (19 centimeters), and it may be normal when the diameter of Bandelocque is less than $7\frac{1}{4}$ inches (18 centimeters). Contraction in other diameters must be excluded.

An interspinal equal to or greater than the intercrystal diameter indicates flattening of the pelvis; when both are small, there is general contraction.

3. VAGINAL EXAMINATION.

Before examining *per vaginam* the obstetrician's hands and the external genitals of the patient are to be cleansed with the same care that is observed during labor.



Measuring the external conjugate: the black dots show the points from which the measurements are taken (from a photograph).





Manual method of measuring the diagonal conjugate: P, promontory; P, B, perineal body displaced backward.

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In parous women the pelvic floor and the cervix are examined for injuries inflicted during previous labors. In all cases the diagonal conjugate and the antero-posterior and bischial diameters at the outlet should carefully be measured and the width and curvature of the sacrum be noted. The method of measuring the diagonal conjugate is shown in Figure 195 and Plate 26. With the patient in the lithotomy position, two fingers of the examining hand are passed into the vagina, and the tip of the second finger is made to rest by its outer margin against the most prominent part of the sacro-vertebral angle. The point at which the edge of the subpubic ligament cuts the radial border of the examining hand is marked by a finger-nail with the other hand. The distance between the points of contact is the value of the diagonal conjugate. To find the true conjugate the amount to be subtracted from the diagonal is usually $\frac{1}{2}$ to $\frac{3}{4}$ inch, according to the depth and inclination of the symphysis. The diameters of the cavity and the transverse diameter at the brim are estimated by palpating the walls of the pelvis.

The examining hand is to be used wet with the antiseptic solution. If any other lubricant is required, glycerin or vaselin sterilized by heat, or glycerin biniodized or sublimated (1 : 500), may be employed.

THE LYING-IN ROOM.

In private practice the patient is generally confined in the room which she is to occupy during convalescence. The choice of room is not a matter of indifference. One of the first requisites of health at all times is pure air, and this should not be denied the patient at a time when the need of oxygen is greater than usual, owing to the severe muscular activity of labor and to the increased tissue-waste of the puerperium. If possible, therefore, a commodious room, one which permits of constant ventilation, should be selected. In cold weather an open fire is an efficient aid to ventilation, and it adds greatly to the cheerfulness of the lying-in chamber.

A sunny exposure is desirable. Dust-laden hangings are especially objectionable, yet it is neither necessary nor best to so far dismantle the room as to make it cheerless. Ordinary cleanliness is usually sufficient.

On no condition should the confinement be conducted in an apartment recently occupied by a patient with erysipelas, childbed fever, suppurating wounds, or other diseases which are recognized sources of possible sepsis, except after systematic cleansing and disinfection.

The management of the patient at the close of labor is simplified if a separate cot be provided for the confinement, the patient being transferred to the bed at the close of the labor.

The Nurse's Preparations.—An orderly nurse will have ready, conveniently near the bed, a small table (Fig. 196) properly equipped with such appliances as the doctor will need for use during the labor. The table should be covered neatly with one or two fresh-laundered towels, and be supplied with a wash-basin, a hand-brush, soap and hot water, an antiseptic solution, scissors, a ligature for the navel, and a suitable aseptic lubricant for the hands.

The nurse should also provide plenty of clean sheets and towels, one or two pieces of unbleached muslin for abdominal binders a half yard in width by one and a quarter yards in length, one or two surgically clean rubber sheets large enough to cover the entire width of the bed, plenty of muslin sheets, a rug or oil-cloth to protect the carpet beside the bed, safety-pins of convenient size for pinning the binder, a fountain syringe, a suitable bed-pan, a supply of hot and of cold water, a package of salicylated or borated cotton for the navel dressing, a blanket for wrapping the child, and the child's clothing.

Preparation of the Bed.—The patient should lie upon a firm mattress. It is customary to protect the bed by means of a rubber sheet, which ought to be large enough to cover the entire width of the bed and the greater part of its

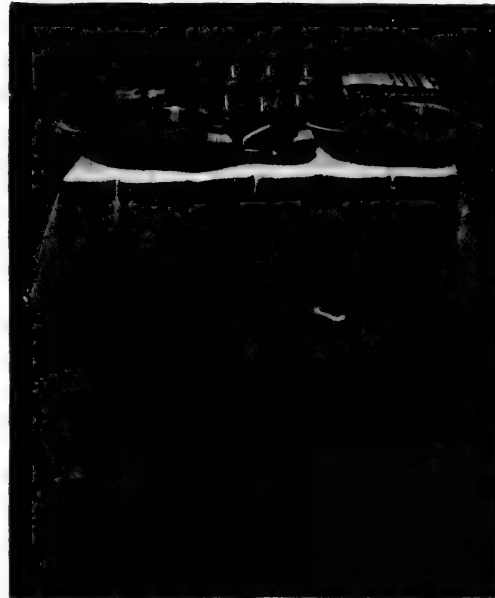


FIG. 196.—Table equipped with basins, brushes, antiseptics, etc., for the physician's use.

length. Over this rubber covering is spread a muslin sheet, the two coverings being pinned fast to the mattress. These spreads are covered with a second rubber overlaid with a bed-sheet. The latter coverings are withdrawn after labor, leaving the bed clean and protected by the first rubber and its muslin covering. Two or three fresh-laundered sheets, each folded to four thicknesses, may be placed upon the bed in position to receive the discharges.

In place of the sheets a good absorbent dressing is a pad specially made for the purpose. It consists of a cheese-cloth sack or bag, which is filled with jute, absorbent cotton, cotton waste, or other absorbent material that has previously been prepared and sterilized. The sack requires to be from $2\frac{1}{2}$ to 3 feet

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square and 3 or 4 inches thick. The pad is best sterilized by steaming for an hour shortly before use. If a separate cot is used for the confinement, it is to be equipped in the manner above described.

An excellent substitute for the absorbent pad is the Kelly rubber-pad, now commonly employed in gynecological operations. It must be sterilized carefully before using.

It is unnecessary to say that the entire dressing of the bed must be clean in the surgical sense.

The Patient.—The patient should be directed to receive a bath at the beginning of labor and to make an entire change of linen. She will usually prefer to be dressed in her night-clothing, over which, during the first stage, she may wear a loose wrapper. A napkin or a pad kept wet with Thiersch's solution and worn over the vulva during this stage is a simple and useful antiseptic measure.

The Obstetric Bag.—It is recommended that the obstetric bag be large enough to contain all the instruments and other surgical appliances that may be needed in ordinary labors. The equipment should comprise obstetric forceps; a Davidson syringe; a hypodermic syringe; a glass uterine douche-tube; a soft-rubber catheter; a soft-rubber tube with bulb attached for aspirating mucus from the child's throat in case of asphyxia; a half-dozen needles,

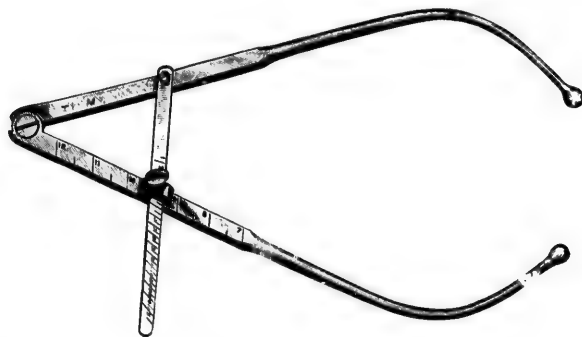


FIG. 197.—Schultze's pelvimeter.

about 2 inches in length and straight or slightly curved, for suturing the perineum; a few short curved needles, an inch to an inch and a quarter in length, for use in the vagina; a needle forceps; a knife for episiotomy; sterilized sutures of catgut, silkworm-gut, and of silk; one or two hand-brushes; a yard or two of iodoform or plain aseptic gauze for possible use in post-partum hemorrhage; a set of Barnes' bags; and a Schultze pelvimeter (Fig. 197).

The additional instruments that will frequently be of service are a Sims speculum, one or two sponge-holding forceps, a volsella, and a curette. A small spring-balance will be useful when it is desirable for scientific or other reasons to know the weight of the child.

The bag should also be supplied with two or three ounces of chloroform, twice as much ether, a few ounces of carbolic acid, and a drachm or two of chloral. Mercurial antiseptics and also obstetric emergents, such as morphin, elaterin, digitalis, ergot, and veratrum viride, are most conveniently carried in tablet form.

3. ANESTHESIA.

Of anesthesia in obstetrics for the usual surgical indications little need be said. The employment of anesthetics in obstetric operations is governed by the well-established usages of surgical practice.

By *obstetric* anesthesia is understood something entirely distinct and apart from the surgical use of anesthetics. It is intended to diminish, not to abolish, pain. Its object is merely to mitigate the severer sufferings of ordinary labor, not to cause complete insensibility.

To what extent anesthetic agents may be used to advantage in a simple labor is a question that calls for the exercise of tact and judgment. That, on the one hand, obstetric analgesia accomplishes a distinct gain, in so far as it spares the patient the exhausting effects of severe pain and prolonged nervous tension, cannot be doubted; nor has the obstetrician any more pleasing duty than to save the needless sufferings of childbed. On the other hand, except in moderate doses and during the most active period of labor, anesthetics are liable to impede the progress of the birth. The careless and long-continued use of these agents, especially in excessive quantities, is fraught with serious danger to the patient. Their abuse is doubtless at times an unrecognized factor in grave and even fatal accidents of childbed. These objections obtain more especially against chloroform.

With reference to the influence of anesthetics upon the strength and the frequency of the uterine contractions we have some recent observations from Dönhoff.¹ He administered chloroform, in various degrees, to five parturients, studying the effect upon the pains with the aid of a tokodynamometer. Even under small doses the labor was retarded. In eight observations the muscular pressure sank nearly to one-half that present before the administration, and the strength of the uterine contractions was not fully restored for several minutes after the inhalations were stopped.

That the use of anesthetics during labor predisposes, in some degree, to relaxation of the uterus in the third stage, as claimed by Lusk and others, is abundantly exemplified in the writer's experience.

The foregoing facts, while they do not forbid the employment of obstetric anesthesia, call for the exercise of caution in its use. When required for no other purpose than to mitigate the sufferings of the patient, anesthetics should be reserved until the latter part of the second stage, and even then they may be withheld so long as the pains are well borne. Their employment is permissible at an earlier period in the labor when, required to subdue great

¹ *Archiv für Gyn.*, Band xlii, 12.

nervousness and excitement or to relieve pains of extreme and unusual severity. In exceptional cases these agents may act to accelerate the labor by counteracting the inhibitory effect of pain upon the uterine contractions.

In the third stage of labor the uses of anesthetics are chiefly surgical. When anesthesia is required to the surgical degree, it must not be assumed that the obstetric patient enjoys any special immunity from the usual dangers of anesthetics. The relative safety of obstetric anesthesia lies not in any peculiarity of the subject, but in the mode of administration, the limited dosage, the slow and gradual inhalation, and the intermittent use of the drug, during the pains only. Under complete anesthesia the parturient woman is exposed to the same dangers as are other patients.

In cases in which an operation must be performed requiring anesthetics, neither disease of the heart, of the lungs, nor of the kidneys, nor the exhaustion of the third stage, forbids their use. These conditions, however, necessitate increased caution in their administration. In cardiac disease, even in lesions of the myocardium, anesthetics lessen the danger by subduing the reflexes.

Choice of Anesthetics.—For mere obstetric analgesia chloroform is generally preferred. It has the advantage of being pleasanter than ether and is less bulky to carry. The latter agent seems to be growing in favor, however, for obstetrical use, and it is claimed to be no less manageable than its rival, chloroform, for partial anesthesia. Hirst thinks analgesia is even more promptly produced by ether than by chloroform. The satisfactory use of ether for this purpose, however, depends upon its proper administration. It must be given very gradually in quantities of a few drops with each inspiration. The difference in the safety of the two agents is insignificant when used in the obstetric method.

When complete insensibility is required for surgical interference, chloroform should, as a rule, give place to ether. The general mortality of chloroform when pushed to the surgical degree is four or five times greater than that of ether. Of the two agents, chloroform is the more potent and its effects persist longer after inhalation stops. Ether, since it is used in larger quantities, is more irritant to the air-passages than is chloroform; hence the former agent should be replaced by chloroform in inflammation of the air-passages, especially if it be acute. Ether is generally believed to be more dangerous in nephritis than is chloroform, but this question is not fully settled. Owing to the tendency of the former agent to produce high arterial tension, it is dangerous in marked atheroma.

Method of Administration.—The patient is prepared for anesthesia by loosening the clothing, by lowering the head, and by attention to such other precautions as are commonly observed in surgical practice. To protect the skin from the irritating effects of the chloroform vapor the lips, nose, and chin may be smeared with vaselin or with glycerin. A towel spread in one thickness over the head, and lifted by the middle so as to form a large air-chamber about the face (Fig. 198), makes a suitable inhaler. An Esmarch

mask is also a convenient apparatus for administering the anesthetic in the lying-in room.

On the first premonition of a coming pain the inhaler is placed over the face of the patient, and the anesthetic is dropped upon it opposite the mouth. With chloroform, one drop or, at the most, 2 drops should be let fall at each breath. In case ether is used, 3 or 4 drops with each inspiration will suffice. When sufficient effect is not obtained in this manner, the patient may be requested to breathe rapidly as the pain is coming on.

For convenience in graduating the administration a bottle specially constructed for the purpose may be used, or a dropping-bottle may be improvised by cutting a longitudinal slot in the side of the stopper (Fig. 198).

The foregoing methods of administration ensure abundant dilution of the anesthetic vapors with air and a safe and gradual development of anesthesia



FIG. 198.—Method of giving chloroform with the towel inhaler: the illustration represents the towel as transparent (from a photograph).

with the least possible quantity of the drug. The inhaler should be removed on the approach of unconsciousness, and should always be withheld in the intervals between the pains. During the severer pains at the acme of expulsion the inhalation may usually be pushed nearly or quite to the surgical degree.

Other Anesthetic Agents.—An agent of great value as a partial substitute for the anesthetic vapors is chloral. It is particularly useful for alleviating the pains of the first stage when they are not well borne. From 45 to 60 grains may be given in doses of 15 grains repeated every twenty minutes. The total quantity should not exceed a drachm. Under the full dose the

patient usually bears the pains with little complaint, and sleeps quietly in the intervals. Chloral in the quantity mentioned has no inhibitory effect upon the uterine contractions. In disease of the heart, either organic or functional, the wisdom of its employment is questionable, owing to its depressant effect. It is said by some authorities to be unsafe to give chloroform to a patient who is already under the influence of chloral.

The coal-tar analgesics relieve the pains of labor, but they also tend to cause uterine inertia.

The hydrochlorate of cocain applied to the cervix and vagina has proved of little service, its action being merely superficial. It is especially objectionable on the ground that it necessitates interference within the passages.

From an eighth to a quarter grain of the sulphate of morphin, administered hypodermatically, as a rule acts kindly in unusually painful labors, but it is rarely to be recommended in strictly normal conditions.

EXAMINATION DURING THE LABOR.

The first duty of the obstetrician on reaching his patient in response to her summons is to satisfy himself that she is, as she assumes, actually in labor. The beginning pains, however, are not necessarily to be taken as evidence that active labor is near at hand. Painful uterine contractions are sometimes experienced at intervals for days before the birth. Rarely, after they are fully established, they may wholly cease for hours.

Inquiry is made for the usual phenomena of beginning labor, the time when the pains began, and their character, strength, and frequency. Most distinctive of labor is the rhythmical character of the pains and the contraction of the uterus during the pains as felt by the hand laid upon the abdomen. The first uterine contractions of childbirth frequently give rise to little more than a sense of pressure in the sacral and the lumbar region. As the labor progresses they are felt in front over the lower abdomen, and finally radiate down the thighs. If the labor is in actual progress, a systematic external and internal examination is to be made. The general object and method are substantially the same as in the preliminary examination, with the addition of certain details which pertain more especially to the labor.

The abdominal examination aims to determine whether the child is living, what is the presentation and position, the quality and frequency of the fetal pulse, how far the head has descended in the pelvis, the presence of anomalies that may complicate the birth. The relative size of the head and pelvis can be estimated by observing how far the head has sunk or can be made to sink into the excavation. In doubtful cases measurements of the head may be taken with calipers through the abdominal wall. Distention of the bladder is recognized by palpation over the suprapubic region.

The diagnosis of presentation and position by abdominal palpation is not usually so readily made at this time as before labor, but in most cases it offers no special difficulty. The character of the fetal heart-sounds affords important information as to the prognosis for the child, and they should fre-

quently be listened to throughout labor. A fetal pulse-rate much above or below the normal range, or a pulse which grows progressively weaker, indicates danger to the child.

When a systematic preliminary examination has been made, little additional information remains to be gained by examining internally after labor begins.

For the detection of possible complications that may have developed at the onset of labor, such as prolapse of the cord or of a fetal member, as well as for more precise information of the stage of progress, a vaginal examination is usually desirable, even though the obstetrician be expert in abdominal palpation.

Before examining internally the nurse is directed to cleanse the abdomen, the vulva, and the inner surfaces of the thighs with soap and water, and finally with an antiseptic solution; meantime the obstetrician sterilizes his hands and forearms.

The object of this examination is to learn—(1), the condition of the vulva and the degree of resistance it will be likely to offer as the head descends; (2), whether the vagina is well lubricated by the secretions, and the presence or absence of obstruction; (3), the condition of the cervix, how far dilated, whether dilatable as judged by the extent of softening and thinning; (4), the size and protrusion of the bag of waters; and (5), the presentation and position of the child in confirmation of the abdominal examination.

Vertex presentations are recognized by the hardness and the globular shape of the cranial portion of the head and by tracing the sutures and fontanelles. As the anatomical characters of the presenting part are often somewhat obscured by the caput succedaneum, the examination must be made with care, using firm pressure and searching as far as the fingers can reach. In other than vertex presentations still greater pains will generally be needed to identify the presenting part. During the vaginal examination the hardness of the child's head should be taken into account as an important element in the prognosis. The position is determined by finding in which quadrant of the pelvis the small fontanelle lies. This is best located by first tracing the sagittal suture. (For diagnostic signs of other than vertex presentation the reader is referred to the chapter treating of those presentations.)

The examiner will learn whether the membranes are still intact, and how far they protrude during a pain, and will make sure that a loop of the cord has not prolapsed into the bag of waters. It is perhaps unnecessary to say that in this part of the examination care will be needed lest the membranes be prematurely ruptured.

To the question which is invariably asked, "How long will the labor last?" a guarded answer must be given. Definite predictions are seldom possible at the beginning of labor. The prognosis, so far as it can be estimated, must be based on the strength and the frequency of the pains, the extent of dilatation and the dilatability of the cervix, the position, size, and hardness of the head, and the degree of descent. When nothing abnormal has been discovered assurance should be given accordingly.

MANAGEMENT OF THE FIRST STAGE.

During the first stage of labor the patient ought not, as a rule, to be confined to the bed until dilatation is well advanced. She is usually more comfortable if allowed the liberty of the room, and the pains are thereby promoted. Much walking is not advisable, however, before the head has engaged; it may favor prolapse of the cord or of the small parts, and may hinder engagement. If the membranes rupture or if the pains assume unusual intensity, the patient must be kept in a reclining posture upon the bed or a lounge.

Malpositions are often capable of correction by postural methods, the woman being required to lie upon the side toward which that part of the head points that is to lead the descent. For example, in a right occipito-posterior position the patient should lie upon the right side, and in a left posterior position of the occiput upon the left side.

The clothing should be loose, and be limited to a wrapper and the under-clothing.

If the physician in his first examination has satisfied himself of the absence of complications, the vaginal examination will rarely need to be repeated until after the rupture of the membranes. When the protruding bag breaks before the head is engaged, it is well to make sure that a loop of the cord has not been swept down with the gush of waters. If the first stage is unduly retarded, a careful digital exploration by the vagina may be needed to learn the cause of delay.

The physician's first visit should be prolonged sufficiently to form some estimate of the probable rapidity of the labor and of the length of time before his attendance will again be required. On departing all needed instructions should be left with the nurse. The patient is to be allowed such food and drink as may be necessary, to be warned against voluntary expulsive efforts, and is usually to remain out of bed until the pains are severe. The lower bowel should be cleared and the bladder frequently evacuated.

During this stage it is a general rule for the physician not to remain with the patient until the os has reached the size of a silver dollar. Even after his continuous presence at the house is required, he will better, in most cases, absent himself from the room, except when his attentions are needed by the patient.

Throughout the labor idle bystanders should, as a rule, be excluded from the lying-in chamber. The presence of the husband is a matter to be left to himself and the patient.

Both the maternal and the fetal pulse should occasionally be counted.

All manipulations within the passages for the purpose of accelerating the labor in normal cases are to be scrupulously avoided.

Rarely when the anterior lip of the cervix is caught over the occiput, and apparently retards the progress of the labor, it may be hooked forward during a pain until it retracts above the head. This is a practice, however, that is very liable to abuse.

MANAGEMENT OF THE SECOND STAGE.

In the second stage of labor, as in the first, so long as all is normal the duties of the obstetrician are few and simple. From the time dilatation is nearly complete the patient must not, as a rule, be allowed to leave her bed, not even for evacuations of the bladder or the bowels. She is to be dressed in the usual night-clothing, which the nurse will keep well tucked under the arms, beyond the reach of soiling. A folded sheet hung like a skirt from the hips still further conduces to cleanliness. When the pains are feeble, their intensity may be increased by requiring the patient to move about in bed or even to assume for a time a sitting or a half-sitting posture. The uterine expulsive efforts should be reinforced by the voluntary muscles. Direct the patient to "hold the breath and bear down with the pains."

Most women during the expulsive pains instinctively brace their feet and catch the hands of the nearest bystander to assist the straining effort by pulling. Except in precipitate labor this practice is to be encouraged. A sheet rolled into a loose rope and fastened by one end to the foot of the bed makes a convenient and efficient sling for the purpose.

An abdominal binder is frequently useful in helping the progress of labor during the second stage, particularly in multiparæ having lax abdominal walls.

The distressing sacral pains so common in the expulsive stage of labor may be relieved in some degree by pressure over the painful region. For this purpose the nurse, taking position on the bed behind the patient as she lies upon the side, supports the back by pressing firmly against the sacrum with the palms of the hands during the pains.

Cramps in the lower limbs are best overcome by powerfully contracting the antagonistic muscles. In case of cramps in the calf of the leg, for example, the patient should forcibly flex the foot and hold it so until the muscular spasm subsides.

Rupture of the Membranes.—When the bag of membranes does not burst spontaneously by the time it reaches the pelvic floor, it should be ruptured by the obstetrician. Care must first be taken to see that a loop of the cord has not slipped down beside the head, as that condition of things would seriously be complicated by the escape of the waters. It is not usually difficult to tear the sac with the finger-nail during a pain. Failing by this method, a sharp-pointed scissors, previously sterilized, may be used. A convenient instrument for the purpose, generally to be found in the lying-in room, is a coarse hairpin. It is first straightened and then well flamed. This perforator is passed on the finger-tip as a guard and a guide, and the bag of membrane is punctured while tense during a pain.

Obstetric Position.—As a rule, the posture of the patient should be left largely to her own choice. Occasional changes relieve fatigue. In simple slow labor the pains are promoted by permitting her to move about in bed and now and then to take a sitting position. Until the head reaches the pelvic floor a half-sitting posture is the most favorable, since the

propelling force thus acts most effectively in the line of descent. At the perineal stage the lateral position with the body flexed, which position is most advantageous for the obstetrician, is at the same time advisable from the standpoint of the mechanism. The lower end of the sacrum is tilted backward, and some advantage, perhaps, may be derived from the fact that gravity acts more nearly in the axis of expulsion.

Frequency of Vaginal Examination.—Vaginal examinations should be as infrequent as possible. There is seldom occasion in normal conditions for more than one or two internal examinations, at the most, during the expulsive stage. The descent of the head may be followed by palpating over the lower abdomen until the occiput has reached the floor of the pelvis. From that time the progress of the descent may be noted by the touch through the pelvic floor, and during the last moments of expulsion by ocular inspection.

All that the obstetrician needs to know in normal cases can usually be learned by abdominal palpation and auscultation. Frequent vaginal examinations expose the patient to possible infection in spite of due care in the matter of subjective asepsis. Particularly is this the case when the manipulation extends into the lower uterine segment. Pathogenic bacteria, which are primarily present in the vagina and which remain innocuous in the acid vaginal secretions, may become active when transferred to the alkaline secretions of the cervix or the uterine cavity.

Prevention of Injuries to the Pelvic Floor.—The frequency of pelvic-floor lacerations in term deliveries in general practice may fairly be estimated at about 35 per cent. in first, and 10 per cent. in subsequent, labors. In little less than half this number the injury must be regarded as unavoidable, except by substituting incisions.

In strictly normal conditions the muscular structures of the pelvic floor slowly relax under the pressure of the gradually-advancing head and escape intact. The fourchette, however, is frequently torn in first births. In relatively small vulvo-vaginal outlets and in rigidity of the structures from whatever cause the parts will generally be lacerated during the expulsion of the head in spite of the most skilful efforts of the obstetrician.

The order in which the tissues give way is fascia, muscle, mucous membrane, skin. Accordingly, a laceration may occur subcutaneously, the tear being confined to the muscles and fascia and no breach of continuity appearing to the eye.

Numerous procedures have been proposed for the prevention of perineal injuries during delivery. The discussion in this place of the various methods that have been upheld by obstetric writers would serve no useful purpose. Most of them must be regarded as irrational and useless, if not even mischievous.

When we reflect that the cause of the tear is undue strain upon the resisting girdle through which the head passes at the moment of expulsion, it is plain that any measure to be of value in preventing the injuries in question must do one or both of two things: It must act to promote the relaxation

and distensibility of the pelvic floor, or to lessen the tension to which it is subjected during the birth, or both. The former object is best accomplished by the slow and gradual delivery of the head, permitting time for the tissues to stretch; the latter, by so regulating the expulsion of the head as to keep its smallest circumference in the grasp of the resisting girdle and the propelling power directed in the axis of the outlet.

The rate of descent is perfectly at command of the obstetrician. The



FIG. 199.—Regulating the birth of the head (from a photograph).

expulsive force of the abdominal muscles may sometimes be suspended by requiring the patient to breathe rapidly during the pains. This, however, is not always possible. The action of the abdominal muscles is at this stage frequently involuntary and wholly beyond the patient's control. Most effect-

ual for the regulation of the expelling powers is the use of anesthetics. Chloroform or ether should be given at this period on the appearance of the slightest danger of laceration. By the judicious use of the anesthetic the strength and frequency of the pains and the rapidity of expulsion may be regulated at will.

The advance of the head, however, can still further be controlled by pressure with the thumb and finger held constantly upon the occiput. With the thumb applied to the head immediately in front of the tense border of the perineum, and with two fingers resting upon the occiput, the rate of descent is easily watched and regulated.

To keep the tension of the vulva at a minimum, the long axis of the cephalic cylinder must be kept at a right angle with the plane of the outlet of the soft parts. Too rapid extension of the head must be prevented. The forehead should not be permitted to pass the perineum until the occiput is fully expelled and the nape of the neck rests in the subpubic arch.

Moreover, to guard against too great strain upon the pelvic floor, the direction of expulsion must be regulated by crowding the head well up in the pubic arch, especially at the time when the equator of the head passes the vulvar ring. The expelling force is thus directed in the axis of the outlet, and the least possible downward thrust is exerted upon the pelvic floor.

The foregoing manipulations are best conducted with the patient in the left lateral position. In first labors, therefore, and in others in which the perineum is liable to be torn, the patient should, as a rule, be placed upon the left side, with the buttocks close to the edge of the bed, as soon as the head has reached the floor of the pelvis. There is rarely danger of laceration until after the occipital pole appears in the vulvar fissure. Up to this point usually the progress of the perineal stage, when not over-rapid, may be noted by the touch alone. With the finger upon the perineum just behind the posterior vulvar commissure the occiput can be felt through the soft parts some time before it begins to distend the perineum, and the rate of descent can be observed as accurately as by passing the finger within the passages.

From the moment the occiput appears in the vulvar orifice the parts ought to be under ocular inspection. The vaginal discharges are occasionally washed away with a cloth which is kept lying in a warm antiseptic solution. The tension of the resisting ring may be tested by now and then passing the finger within the vaginal orifice during a pain. The head is allowed to advance during a pain until the perineal edge becomes as tense as is deemed safe. Its further progress is then arrested by direct pressure with the fingers in the line of descent (Fig. 200). Until about to be expelled, driven down with the pains, it recedes in the intervals, and by this to-and-fro movement the pelvic floor is moulded as it were to the required degree of distention.

When the bregma appears at the edge of the perineum, the head no longer recedes between the pains and is on the verge of expulsion. During the



FIG. 200.—Regulating expulsion of the head with the fingers of one hand against the occiput.

passage of the equator of the head extension must be prevented by upward pressure in the axis of expulsion with the thumb placed upon the sinciput close to the perineum, the fingers resting upon the occiput. The sinciput must not be permitted to advance faster than the occiput. If required for the better control, both hands may be used (Fig. 201).

A favorite method for managing the expulsion of the head is the following: The patient lying upon the left side close to the edge of the bed, the operator, sitting behind her, grasps the head with the fingers of the right hand placed just in front of the fourchette, while the left hand, passed over the abdomen and between the thighs of the mother, seizes the occiput

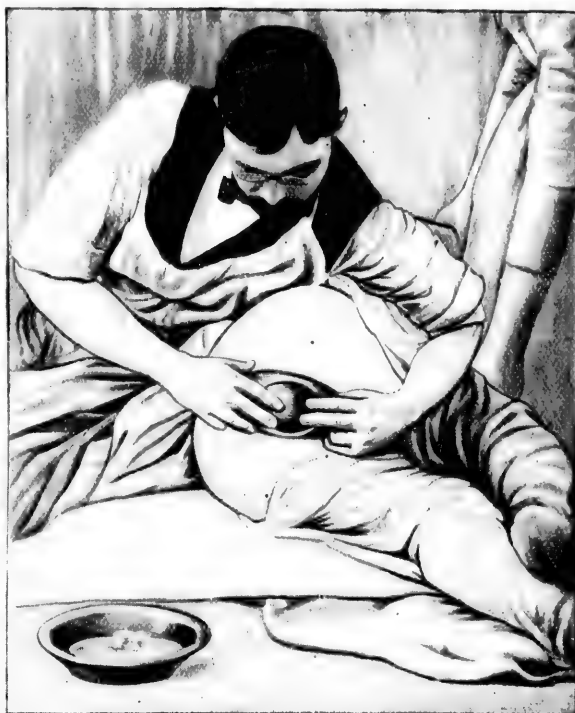


FIG. 201.—Preferred method for regulating expulsion of the head.

(Fig. 199). This procedure gives easy command of the birth of the head, yet offers no important advantage over simpler methods. The writer prefers to this the manipulation shown in Figure 201.

As a rule, in first labors a half hour or more from the time the pelvic floor begins to be distended will be required before the head can safely be allowed to pass. In subsequent births a shorter time will usually suffice.

While the procedures just described are to be recommended to the general exclusion of other methods, there is no objection to the use of gentle pressure

applied to the head through the lateral aspects of the pelvic floor. For this purpose the hand may be laid flat upon the bulging soft parts with the thumb extending along the right, and the fingers parallel with the left, labium. The hand should rest lightly upon the median thinned-out portion of the perineum, the pressure being applied mainly to each side of it. It must be borne in mind, however, that the object is to regulate the expulsion of the head, not to support the perineum. Much compression of the tense pelvic floor, especially its thinned-out median portion, between the child's head and the obstetrician's hand, must tend rather to increase than to diminish the danger of rupture. If the patient lies upon the back during the perineal stage, it will be found more convenient to regulate the expulsion by the thumb placed upon the occiput and the first two fingers upon the head in front of the frenulum.

The introduction of the finger into the rectum for the purpose of shelling out the head, even when practised between the pains, is more likely, as a rule, to cause than to prevent laceration by too precipitate delivery.

It is difficult to understand how the tendency to rupture can be diminished by drawing the perineum forward with the finger in the rectum, as advised by Goodell. As Garrigues has pointed out, an elastic ring encircling a cylinder is subjected to less tension when at a right angle to the cylinder than when oblique. Moreover, interference within the rectum, however practised, is hardly consistent with the requirements of aseptic obstetrics.

Episiotomy.—No method yields better results for the ultimate integrity of the perineum than episiotomy rightly timed and properly executed. The ultimate condition of the pelvic floor after episiotomy correctly performed is even better than after many natural deliveries in which the parts escape rupture. The tonicity of the structures frequently remains as perfect as in the non-parous woman.

The success of the incisions in preventing laceration depends, as already intimated, upon so timing them as wholly to anticipate the tearing, and upon carefully adjusting the location and direction of the cuts. This apparently simple procedure, therefore, is one in which even the accomplished obstetrician may find room for the exercise of skill.

The only instrument required, in addition to what is carried in the usual obstetric outfit, is a blunt-pointed tenotomy knife. When laceration seems inevitable or even probable, the cordlike ring, which can be felt about half an inch above the tense border of the vulva by examination during a pain, should be divided. Locating the resisting girdle by the finger, the knife is passed flatwise between the head and the vaginal wall. The edge of the knife is then turned outward and the ring incised. The operation is repeated on the opposite side. The length of the incision should be about one inch, its depth a quarter-inch, and its location about one-third way from the posterior to the anterior commissure when the parts are on the stretch. The structures involved in the incision when made in this manner are unimportant. They consist usually of the skin, fascia, and probably the bulbo-cavernous muscle.

Most essential is it that the cuts be made parallel with the long axis of the mother's body, not with the vaginal axis. The cuts will then be found on examination after labor to run parallel with the outlet of the birth-canal. If



FIG. 202.—Double episiotomy (sketch, just after delivery, from nature, R. L. Dickinson): A, direction of incision faulty, pointing toward the posterior vaginal wall; B, correct line of incision, running parallel with the axis of the vulvar opening.

the knife be held in line with the axis of the vulvo-vaginal outlet as the latter appears at the time of incision, its point will be liable to invade the very structures the operation aims to save; the posterior ends of the incisions will be found after delivery much nearer the median line than was intended, and the transversus perinei and other important structures will possibly be divided. This result is well shown in the accompanying illustrations by Dr. R. L. Dickinson¹ (Figs. 202, 203).

If preferred, the resisting ring may be divided with scissors. After labor the cuts should immediately be reunited with stitches. A running or an interrupted suture with fine catgut best answers the purpose. The wounds may generally be closed without waiting for the delivery of the placenta, thus saving the necessity for renewing the anesthesia. During the suturing the patient may lie on the back or on the

side opposite the one being repaired.

Management of the Cord.—The moment the head is born a finger is slipped within the passages to ascertain if the cord is coiled about the child's neck. When so found, the loop or loops should be drawn down one by one over the head. Should the coil be so taut that it cannot be brought down—an accident that must be extremely rare—the cord may be tied at two points, and be cut between the two ligatures and the trunk promptly delivered.

Delivery of the Trunk.—The head should now be held in the hand to keep it in the axis of expulsion. Contrary to the usual teaching, the writer prefers to deliver the posterior shoulder first. While the anterior shoulder lies behind the symphysis the finger is passed over the dorsal aspect of the posterior shoulder and is slipped into the axilla. The posterior shoulder is then folded forward and is cautiously lifted over the perineum.

Except in emergency calling for immediate delivery in the interest of mother or child, the expulsion of the trunk is left to nature. It is not good practice to drag the child out of the uterus. The uterus should be compelled to expel it. The presence of the trunk and the extremities stimulates contrac-

¹ "The Direction of the Incision in Episiotomy," *Trans. Am. Gyn. Soc.*, 1892.

tions, and time is permitted for retraction. When necessary the expulsion of the trunk may be hastened by the use of friction over the uterus.

The frequency with which perineal injuries occur during the delivery of

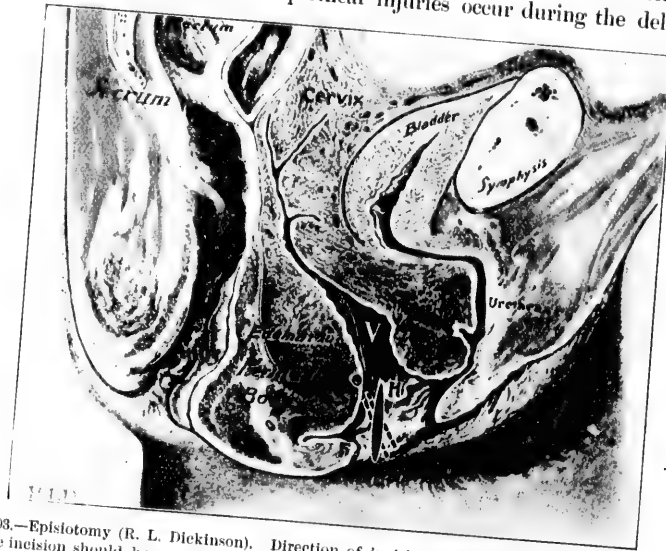


Fig. 203.—Episiotomy (R. L. Dickinson). Direction of incision: The black line shows the direction which the incision should have, as it appears after delivery, in line with the axis of the vulvo-vaginal outlet; the dotted line illustrates a faulty incision, dipping into the middle section of the pelvic floor.

the shoulders is probably exaggerated. It is easy to attribute to the shoulders a rupture which had occurred undiscovered during the birth of the head.

On the expulsion of the head the face should be bathed, and the skin about the eyes should carefully be cleansed and thoroughly dried as a preventive against ophthalmia. Mucus in the pharynx should quickly be removed by the finger covered with a piece of soft wet muslin or by the use of a soft-rubber tube with an aspirating bulb attached.

Ligation of the Cord.—The time for tying the cord is by no means a matter of indifference. Systematic observations have shown that the child gains from 1 to 3 ounces of blood by delaying the ligation for several minutes after birth; that in cases thus treated the children are notably more robust than when immediate ligation has been practised, and that the usual loss of weight during the first few days of infancy is diminished.

This post-natal transfusion of blood is a fact of no little importance, especially in prematurely born and anemic or puny children. According to Budin and Ribemont, it is mainly the result of thoracic aspiration. Schücking, Porak, and Fritsch, however, attribute it chiefly to the pressure exerted upon the placenta by the uterine contraction and retraction. Caviglia, who has recently restudied the subject,¹ supports the latter opinion. He calls attention to the fact that since there is frequently a diminution

¹ *Nouvelles Arch. d'Obstet. et de Gyn.*, vii. Année, Nos. 11, 12, et viii. Année, Nos. 1, 2.

of the weight of the child in the first moments after birth from relaxation of the uterus, too early ligation of the cord exposes the new-born infant to the loss not only of reserve blood, but also to a part of its own.

Since the child's heart may be endangered by forcing too much blood into the circulation, compression of the uterus should not be practised before the cord is tied.

In certain emergencies immediate ligation may be necessary, owing to conditions of the mother requiring the obstetrician's entire attention. In case of well-developed, vigorous infants the rule of late ligation loses much of its importance.

The practice now usually observed is to tie the cord after notable pulsation has ceased and the respiration is fully established. If, as seems probable from the researches of Caviglia, the principal cause of the afflux of blood is uterine pressure, neither the child's respiration nor the funic pulse is the true guide to the time for tying the cord, but rather the first firm contraction of the uterus.

In case of twins the cord should always be ligated on the maternal as well as on the fetal side, owing to the possible existence of a vascular connection between the two placentas.

A suitable material for the ligature is narrow linen bobbin. For greater security against hemorrhage a rubber elastic band may be used. It is perhaps needless to say that the material should be surgically clean. It may be left in the antiseptic solution until wanted.

The common practice is to tie from one and a half to three inches away from the umbilicus. For this rule, in the absence of a navel-cord hernia, there is apparently no better reason than custom. It is in the interest of an aseptic healing of the navel wound to reduce to a minimum the amount of necrotic material in the stump. The ligature should therefore generally be placed not more than half an inch from the cutaneous line. It is to be tied as tightly as it can be drawn, with care to put no strain on the umbilical insertion. Before tying, the cord, except it be already thin, should be pinched firmly between the thumb and finger at the point to be ligated. This procedure is better than stripping, which is liable to do violence to the navel.

The cord is divided within a quarter-inch of the ligature. It is cut with clean scissors while held in the hollow of the hand to guard against injuring the child. A bit of cheese-cloth pressed a few times against the cut end of the stump will show whether the vessels are securely tied. It is a common practice to place a second ligature a short distance from the first to control the maternal end of the cord. This promotes cleanliness and, it is generally believed, favors the placental expulsion. The latter claim, however, is doubtful.

MANAGEMENT OF THE THIRD STAGE.

Not the least important duties of the obstetrician in the conduct of natural labor fall in the third stage. Upon the skill and attention given to this period

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the immediate safety of the woman and the rapidity and completeness of her recovery will often in great measure depend. The chief dangers of this stage are those which grow out of a relaxed condition of the uterus—hemorrhage, embolism, and the retention of clots favoring sepsis and subinvolution. The management of the third stage is therefore mainly addressed to uterine contraction and retraction. From the moment the head is born the uterus should constantly be watched, with the hand held flat upon the abdomen over the fundus, until evacuation is complete and the uterine globe as hard as a cricket-ball. After the expulsion of the child the patient is placed on her back. The nurse, if she be competent, may be trusted to hold the fundus, at least while the phy-



FIG. 204.—Credé's method of expressing the placenta, showing also episiotomy incisions (photographed from nature).

sician is occupied with other duties. The hand is to be held quietly upon the abdomen so long as the uterus retains its normal consistence. Should the contractions be feeble, they may be stimulated by gentle friction. This stimulation is best practised by moving the lax abdominal walls over the uterus with a circular motion of the hand. More active interference is seldom required in normal cases. Marked flabbiness of the uterine tumor and indistinctness of outline call for more energetic measures to provoke contraction.

When the placenta is not expelled after a reasonable time, resort should be had to the method of Credé, as follows: A half hour after the termination of the second stage is allowed for the detachment of the after-birth. If at the expiration of that time the placenta is still undelivered, friction is applied to

the uterus until a vigorous contraction is induced. The hand is then placed in such position upon the abdomen that the fundus rests in the hollow of the hand with the thumb in front and the four fingers behind (Fig. 204). At the height of the contraction the uterus is compressed and thrust downward in the direction of the pelvic axis. If not at once successful, the process is repeated at short intervals until the object is gained. Until recently Credé advocated much earlier interference. Shortly before his death he recommended waiting thirty minutes. His procedure is now generally adopted. The expectant plan still advocated by certain authorities is open to the objection that the placenta may be retained for hours, during which the patient is exposed to the danger of hemorrhage and is deprived of much-needed repose.

Traction upon the cord while the after-birth lies in the upper uterine segment is inconsistent with the normal mechanism of placental expulsion. When the placenta has passed into the lower segment of the uterus or the vagina, no harm will be done by gently pulling the cord to assist the delivery.

As the placenta is extruded the membranes are gradually detached from the uterus, care being taken that no fragments are torn off and left behind. To prevent this the placenta is caught in the hand as soon as it passes the vulva, and if the membranes are not already free they should be twisted into a rope by turning the placenta over, and the twisting continued until the separation is complete. Should a strip of membrane accidentally be left in the passages, it may be removed, if in the vagina or hanging from the cervix, by grasping it with the fingers and gently drawing it away, or by seizing it with sterilized catch-forceps and twisting it off. Fragments of membranes remaining wholly in the uterine cavity above the cervix are, as a rule, better left to be expelled with the lochial discharge unless they give rise to hemorrhage. Placenta and membranes must be examined carefully to see if they are complete. Possible anomalies of the after-birth or the cord may also be looked for. To make sure that both amnion and chorion are entire the membranes are best examined by transmitted light.

The duties of the obstetrician, even in strictly normal labor, are by no means ended with the delivery of the after-birth. The third stage is not complete until uterine retraction is fully established. For at least a half-hour after the placenta comes away the uterus is to be watched with the hand upon the abdomen, using friction if necessary to provoke contraction. It is a useful precaution to give a half-drachm of the fluid extract of ergot at the close of labor if the uterus is not firmly contracted. Its use is proper only after evacuation of placenta, membranes, and clots. Its action is most prompt and certain when injected subcutaneously. One or two doses may be left with the patient with instructions that they be taken in the event of flowing too freely. The use of a moderate dose of ergot at the close of labor is not only harmless, but it is also entirely in keeping with the objects of treatment at this period. It limits the danger of hemorrhage, and by diminishing the blood-supply it promotes involution. It closes the gates against infection, guards against the retention of blood-clots in the uterine cavity, and

therefore lessens the tendency to after-pains and to putrid accumulations in the uterus.

REPAIR OF LACERATIONS.—*Cervical lacerations* should be sutured at the close of labor in case they give rise to much hemorrhage. In the absence of troublesome bleeding the advantage of the primary suture is doubtful.

The method of operating is as follows. No anesthetic is required. The cervix is most readily brought down within easy reach when the patient is on the back. She may lie across the bed with the hips close to its edge, or still better on a firm table. If necessary, the perineum may be retracted with a large Sims speculum. The anterior vaginal wall may be held up out of the way with a retractor, if required. The cervix is drawn well down with a volsella. The lips of the wound are most conveniently held in contact with a single volsella, one hook being caught in each lip near the lower end of the tear. The first suture should be passed just above the upper angle of the laceration and tied. This suture, if properly placed, controls the bleeding. The other sutures are then applied as in the secondary operation. The material may be waxed silk or silver wire. The former is recommended as being more manageable, and it has, in the writer's experience, proved entirely satisfactory when well saturated with paraffin wax.

Lacerations of the pelvic floor in general practice probably occur in not less than 35 per cent. of first and in about 10 per cent. of subsequent labors. This percentage of injuries, however, is capable of considerable reduction under proper management of the perineal stage of the birth. In skilfully conducted labors the proportion of lacerations should scarcely exceed 15 per cent. In case of relatively small vulvo-vaginal orifice, narrow pubic arch, unusual rigidity of the pelvic floor, in breech extraction, and in other rapid deliveries notable injuries are inevitable in a large proportion of cases.

The type of laceration most frequently encountered is one that runs nearly in the median line of the superficial structures and to one side of it in the vagina (Fig. 205). Sometimes the wound presents the shape of a Y with one arm to either side of the median line.

Time for Repair.—Unless the condition of the patient at the close of labor is such as to forbid—and this is very rarely the case—lacerations of the pelvic floor should immediately be sutured. Yet perfect union may be obtained



FIG. 205.—Laceration of the pelvic floor, extending half way to the rectum and running toward the right vaginal sulcus (from a sketch at the close of labor by Robert L. Dickinson, M. D.).

by operating at any time within twenty-four hours. The suturing may generally be done with complete success even after so long a period as a week if for any reason it has previously been neglected. When performed thus late the wound-surfaces are first to be vivified by rubbing them with a fold of cheese-cloth, and then made smooth by trimming with scissors.

The writer has frequently repaired lacerations while waiting for the delivery of the placenta. This practice saves time, and generally, too, the renewal of the anesthesia. It is not to be advised in extensive and complicated injuries.

Suture Material.—For ordinary use prepared silk is recommended. Silk-worm gut or silver wire is less likely to cause suppuration along the needle-track, but neither is so easy of application nor so comfortable for the patient. Catgut is best reserved for buried sutures, owing to its tendency when partially exposed to decompose and to lead septic material into the needle-track.

The writer's method of sterilizing silk by immersion for two hours in melted paraffin at a temperature between 240° and 260° F. has in his hands proved satisfactory. A thermometer specially made for the purpose, which can be kept immersed in the melted wax, must be used for regulating the temperature, otherwise the silk is liable to be overheated and charred. The wax employed should be soft, as the harder varieties crumble in handling the thread. A No. 7 silk is a good size for the larger wounds; somewhat smaller sizes may be used for slight lacerations.

Needles.—For use in the external and more accessible portion of the wound the needle should be straight or be slightly curved and about 2 inches in length. For suturing tears high up in the vagina a needle as much shorter as the depth of the wound will permit, and having a more pronounced curve, may more conveniently be used. Needles of the Hagedorn pattern will be found most satisfactory.

Method.—An anesthetic is usually necessary. Ether is to be preferred here, as usual for surgical anesthesia. Small tears may be repaired under cocain anesthesia if for any reason it is desirable to avoid the use of the general anesthetic. Cocain is most effective when injected at several points in the lips of the wound. Not more than a grain at most can safely be used in this manner, and the solution should be rendered sterile by boiling. Many women, however, suffer very little pain from the introduction of sutures, since the tissues have largely lost their sensitiveness by the pressure and contusion received during labor. If care is taken to plunge the needle quickly through the skin-margin at the moment the greatest amount of pain is produced, lacerations not very extensive may be sutured without anesthesia. The patient lies in the lithotomy position, crosswise of the bed, with the hips close to the edge of the latter, or upon a table. The knees are held by assistants or by some of the numerous appliances commonly employed for the purpose in gynecological practice. The sheet sling of Dr. Dickinson has the advantage of being always available.

One of the chief difficulties in determining the extent and character of the

laceration arises from the continuous flow of blood over the parts, obscuring the view. It is generally advisable, therefore, to pack the vagina above the wound with sterile gauze, care being taken to remove it after the operation. Loose tags of tissue which might become necrotic should be trimmed off with scissors.

The type of laceration most frequently met with, as previously stated, runs up one or both sides of the vaginal orifice. The aim must be to re-establish completely the normal relations of the injured structures, and when the levator ani muscle has been torn in one or both sulci, especial pains should be taken to bring into close and accurate apposition the torn edges of this muscle. The sutures are to be applied from the skin-surface when the depth of the wound thus included in each suture would not exceed an inch or an inch and a half. The sutures are placed at intervals of half an inch, beginning at the posterior angle of the wound, nearest the anus. Enter the needle upon the skin close to the edge of the wound. Give it a large circular sweep, and let it emerge in the wound well down to the bottom of the tear; then pass it symmetrically through the opposite lip in reversed direction, entering at the bottom of the laceration and emerging on the skin surface at the edge of the wound. Care must be taken to avoid entering the rectum. The course of the suture should be such that when tied the loop shall be nearly circular. Each stitch after insertion is temporarily tightened as if for tying, to see that it has sweep enough to hold the wound-surfaces in contact throughout the entire depth of the laceration. As the threads are placed, one by one, the ends are loosely knotted together or are held with catch-forceps until all are ready to be tied permanently. The gauze packing is then removed and the wound is cleared of clots. The sutures are tied in the order of insertion. They must be drawn tight enough barely to coapt, but not to constrict, the parts. If the sutures are of silk or of equally flexible material, the ends may be left about an inch in length to facilitate removal.

If the sphincter ani is torn, the ends are to be brought together by two or three special sutures. In complete laceration of the sphincter the muscle-ends tend to retract deeply in the tissues. In these cases by close inspection a pocket or depression may be detected in the wound-surface on either side of the median line. This depression marks the location of the retracted end of the torn sphincter. The end of the muscle is to be caught up with a tenaculum and drawn well out as the suture is passed on either side.

Tears involving the vagina to considerable extent should be sutured on the vaginal surface nearly or quite down to the region of the hymen. These stitches are passed at a right angle to the vaginal axis. The rest of the wound is then sutured from the skin-surface as already described, the plane of each of the latter sutures being nearly at right angles to that of the skin.

Complete tears, extending into the rectum, may be stitched on the vaginal, the perineal, and the rectal surfaces. Owing to the difficulty of removing silk from the rectum, rectal sutures should be of catgut. They should include little more than the mucous membrane of the bowel. The rectal side of the laceration is closed first, the knots being tied in the rectum, resting upon its

mucous membrane, and the remaining wound is sutured on either the perineal, the vaginal, or both surfaces as may be found most expedient. When the rent does not extend up the rectum too far, in addition to the last interrupted sutures tied in the rectum, which coapt the torn ends of the sphincter, a reinforcing stitch will be useful passed in the following manner: While a tenaculum is used to draw out one retracted end of the muscle, the suture is passed through this end of the muscle, and continues its course upward, buried along the edge of the rectal rent, to the apex of the rent; the needle now emerges, and is again buried along the other margin of the rectal rent, and is carefully passed through the other end of the torn sphincter, while a tenaculum draws out this retracted end of the muscle.

In deep tears of any kind the tiered suture is a good one. Beginning at one end of the wound, a layer of the torn structures at the bottom of the laceration is closed with a running catgut suture; this is repeated in a plane next above the first, and so on until the wound is entirely closed. The last tier of stitches, which is partially exposed on the vaginal surface, is best made with waxed silk. It is well to dust the suture-line with some bland antiseptic powder like boric acid, iodoform, or a mixture of both (iodoform 1 part, boric acid 8 parts). For a few days this application may be renewed with each change of the vulvar dressing. The right and the wrong methods of suturing are shown in Figures 206 to 208.

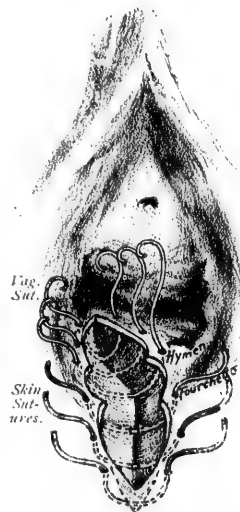


FIG. 206.—Laceration like that shown in Figure 205, with sutures properly placed ready for tying.

solution; her linen, if necessary, is changed; and all blood-stained articles are removed from the bed. For bathing the genitals a piece of fresh-boiled

After-care.—There is no necessity, as a rule, for tying the patient's knees together. The sensitiveness of the parts will be a sufficient safeguard against injurious strain upon the sutures by separating the limbs, and the patient will be much more comfortable without the leg-binder.

Retention of urine frequently results, owing to the reflex disturbance caused by the perineal suture, especially when the latter comes close to the rectum. While injurious distention of the bladder must not be permitted, the catheter should be withheld if possible. Whether the bladder is emptied voluntarily or otherwise, urine must not be permitted to trickle into the vagina or over the suture-line. The bowels are to be kept open, as in other cases, after the second day. The sutures are removed on the eighth or the ninth day.

Toilet of the Patient.—The child is received in two or three thicknesses of flannel, is well wrapped, and is laid in a warm place. The nurse then turns her attention to the mother: soiled portions of her body are to be cleansed, best with an antiseptic

cheese-cloth or towelling is to be used instead of a sponge. Sea-sponges should be banished from the lying-in room. New sponges are difficult to clean, and the ordinary household article is a nest of filth.

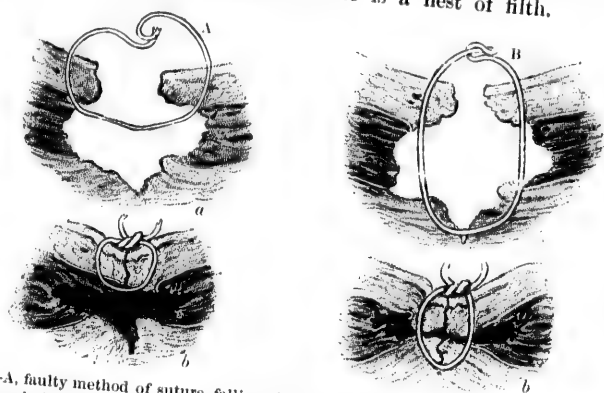


FIG. 207.—A, faulty method of suture, falling short of the bottom of wound and not catching all the muscle-ends: *a*, before tying; *b*, after tying. The latter figure shows dead space at the bottom of wound after tying; perineal body only partially restored. B, suture improperly placed: *a*, before tying; *b*, after tying. The suture (*a*) has too little lateral sweep, and it does not include the ends of all the retracted muscle-fibres at the sides of the wound; *b* shows the result, the pelvic floor being imperfectly restored.

Vulvar Dressing.—After cleansing, the vulva is covered with an aseptic dressing. A fresh-laundered napkin is suitable, or a lochial guard specially

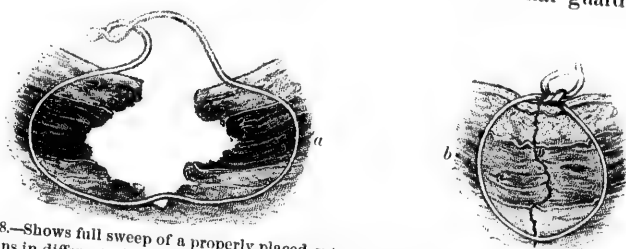


FIG. 208.—Shows full sweep of a properly placed suture: *a*, before tying; *b*, after tying. Even though the tear runs in different planes at different depths, the muscle-ends are held in apposition throughout the entire depth of the wound.

made for the purpose may be employed. These guards are made of absorbent cotton, of cotton waste, or of prepared jute enveloped in cheese-cloth. Suitable dimensions are about 10 inches long, 4 inches wide, and 2 inches thick. Tail-pieces are attached to the guards for fastening to the binder. The guards are burned after using. These dressings are best sterilized by steaming immediately before use. Flowing steam is most effective. They are not employed as occlusion dressings. Their object is rather to promote the cleanliness of the external parts, thus limiting the danger of infecting the passages from the proximity of decomposing discharges. The use of some non-irritant antiseptic like boric acid, bismuth powder, or iodoform helps to retard putrefactive changes. One rubber sheet should be left in place under the linen for four or five days.

A draw-sheet placed under the patient's hips is a convenient dressing for protecting the bed. The draw-sheet consists of a common muslin sheet folded to four thicknesses. It is replaced by a fresh one as often as soiled. Instead of the draw-sheet an aseptic pad similar to the labor-pad, but thinner and smaller, may be preferred.

Abdominal Binder.—The abdominal binder is useful to steady the uterus, and it promotes the comfort of the patient, especially when the abdominal walls are very lax. The usual material is a piece of unbleached muslin $1\frac{1}{2}$ yards in length and about 18 inches in width. This gives width enough to reach from the ensiform to a point below the trochanters (Pl. 27, Fig. 1). Unless the binder overreaches these bony prominences it is liable to slip up, and in a few hours is reduced to a mere rope around the body. Binders ready made with gores to fit the body offer no advantage. The pinning of the binder should begin at the lower border, and at the first application should be fairly tight. If the uterus shows any tendency to relaxation, three folded towels, used as compresses, may be placed on the abdomen under the bandage, one on either side of the uterus and one immediately above it. The binder may be discontinued with after one or two weeks.

Before leaving it is well for the physician to take final note of the pulse and the general condition of the mother, and the nurse should receive all needed instruction in regard to the general care of both patients.

III. THE MECHANISM OF LABOR.

LABOR is a natural process, and it is the province of the accoucheur to restrict himself to watching the processes of nature so long as they are normal and efficient, and to interfere with them only when they become disturbed or inefficient. He is at his best when he is able to compel the faulty efforts of natural labor into a normal course, and he makes a comparative failure whenever he is obliged to substitute for the acts of nature the relatively crude process of an artificial delivery. An ability to restore the normal by making trifling alterations in the mechanical conditions presupposes, however, a most accurate knowledge of the details of the mechanism which governs the usual course of labor, and of the alterations in them which determine the advent of any deviation from the normal. When, moreover, it is remembered that obstetric operations are but efforts to direct an extraneous force into an accurate imitation of the processes of nature, it becomes evident that the first essential to success in obstetrics is the possession of a far-reaching knowledge of the mechanism of labor in its several varieties.

Any intelligent study of obstetrical mechanism must, however, be preceded by a comprehension of the technical terms used in describing it, and of the several classifications by which labor is commonly subdivided into varieties. It is further necessary that the student should possess an accurate knowledge



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1. Abdominal binder and breast-binder in place (from a photograph). 2. Breast-binder in place (from a photograph).

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of the shape and dimensions of the obstetric canal, and of the fetus which is to pass through it. He is then in a position to acquire an intelligent understanding of the principles which underlie the mechanism of all the forms of labor, under the head of a description of its commonest variety, and so easily goes on to understand the modifications in the mechanism that follow upon the alterations in the conditions in the other varieties.

Attitude of the Fetus.—By the attitude of the fetus is meant the position its parts assume *in utero* in relation to one another, in contradistinction to any relation they may bear to the maternal parts.

During the earlier months of pregnancy the uterine cavity is nearly spherical in shape, and it is then so large in proportion to the fetus that its walls are rarely in contact with the embryo. The fetus hangs freely in the uterine cavity, being suspended by the umbilical cord, with its head somewhat lower than its pelvis and with its limbs in a somewhat extended position (Fig. 209). As pregnancy progresses the size of the fetus increases more rapidly than that of the uterus, until in normal cases at term the adaptation



FIG. 209.—Relation between the size of the uterus and the fetus at fifth month (one-sixth natural size).



FIG. 210.—Adaptation between the uterus and the fetus at term, in vertex presentations (one-sixth natural size).

between the two is sufficiently close to make any extended movements of the limbs difficult or impossible. The attitude which the child then assumes is that represented in Figure 210, which is readily seen to be the most compact attitude in which the child can be arranged.

Presentation.—The word *presentation* is used to define the relation which the long axis of the child bears to the long axis of the uterus, and the different presentations are distinguished from one another by the use of adjectives which refer to the part of the child that is to enter the pelvis first in a given case. The several presentations which may occur are cephalic presentations—that is, presentations of the vertex, of the brow, and of the face; presentations of the pelvic extremity, which are subdivided into breech and footling presentations; and transverse presentations, under which are included presentations of the hip, of the trunk, and of the shoulder.

Position.—In obstetric use the word *position* is restricted to a meaning in which it is used to define the relation that the dorsum of the child bears to the dorsum of the mother during its passage through the pelvic canal. Each presentation is subdivided into positions according as the dorsum of the child is directed anteriorly or posteriorly and toward the right or the left side of the mother. Thus we recognize under each presentation four positions, according to whether the part which gives the name to the position is directed left-anteriorly, right-anteriorly, right-posteriorly, or left-posteriorly; for example, vertex presentation, occipito-left-anterior, breech presentation, sacro-right-posterior.

CLASSIFICATION OF LABOR.

Presentations.—The presentations are first of all roughly divided into *longitudinal* and *oblique* presentations. The longitudinal presentations are those in which the long axis of the fetus is in correspondence with the long axis of the uterus; the oblique presentations are those in which there is a considerable angle between the two axes.

The *longitudinal presentations* are, then, those in which either the cephalic or the pelvic end of the fetus is found at the inlet of the pelvis at the beginning of labor—that is, all the variations of cephalic and pelvic presentations.

The *oblique or transverse presentations* include all those in which any portion of the fetus other than the head or the breech is found at the pelvic brim.

Head presentations are divided into those of the vertex, of the brow, and of the face. Pelvic presentations are divided into *breech* presentations, in which both thighs are flexed upon the abdomen when the nates of the fetus enter the mother's pelvis, and *footling* presentations, in which one or both legs are extended and enter in advance of the infant's pelvis. Transverse presentations include presentations of the hip, of the trunk, and of the shoulder; among these presentations those of the shoulder are by far the commonest and most important.

It is also convenient to classify the presentations of the fetus in two other ways, in accordance with the results which may be expected to accrue from their occurrence—namely, into *normal* and *abnormal*, *natural* and *unnatural*, presentations.

Normal and Abnormal Presentations.—A presentation of the vertex occurs in about 97 per cent. of all labors, and, both from its frequency and from the favorable character of its results, is considered to be the only normal presentation, all others being classified as abnormal.

Natural and Unnatural Presentations.—Natural presentations are those in which the conditions are such that they may be expected to terminate, in a large proportion of cases, in delivery by natural or unaided labor. Unnatural presentations are those in which the shape of the presenting part of the fetus is so ill-adapted to the pelvic canal that the labor can ordinarily be terminated only by the intervention of the obstetric art, natural delivery being possible only when the pelvis is exceptionally large and when the fetus is at the same

time immature or exceptionally small. Vertex, face, and breech presentations are classified as natural; brow and transverse presentations are classified as unnatural.

Position.—A division of the presentations into varieties in accordance with the obstetrical positions is a matter of the utmost practical importance, as the mechanism and treatment of labor, and, indeed the prognosis, are often radically different in the several positions of a given presentation. For convenience the most prominent point on the dorsal side of the presenting part is selected for the denomination of the position in each presentation,* in accordance with the relation it bears to a cross-section of the inlet at the beginning of labor.

Vertex.—Vertex presentations are thus divided into positions in accordance with the quarter of the pelvis in which the occiput is found at the beginning of labor. We recognize in vertex presentations four positions: Occipito-left-anterior; occipito-right-anterior; occipito-right-posterior; and occipito-left-posterior.†

Face.—In face presentations the position is named from the position of the chin. The positions are mento-left-anterior, mento-right-anterior, mento-right-posterior, and mento-left-posterior.

Brow.—In brow presentations the positions are somewhat unsatisfactorily classified from the position of the occipital end of the head, as—brow, occipito-left-anterior; brow, occipito-right-anterior; brow, occipito-right-posterior; and brow, occipito-left-posterior.

Breech.—In breech presentations the names of the positions are determined by the situation of the sacrum, as—sacro-left-anterior, sacro-right-anterior, sacro-right-posterior, and sacro-left-posterior.

Transverse.—In shoulder presentations the positions are named from the situation of the presenting scapula, as—scapular-left-anterior, scapular-right-anterior, scapular-right-posterior, and scapular-left-posterior.

For convenience the names of the various positions have long been designated by a conventional set of abbreviations, which are commonly used without the name of the presentation, that being included by implication. The abbreviations now in general use are those which were determined upon by the last International Medical Congress in its session at Washington, D. C. They are as follows: Occipito-left-anterior, O. L. A.; occipito-right-anterior, O. D.‡A.; occipito-right-posterior, O. D. P.; occipito-left-posterior, O. L. P.; Mento-left-anterior, etc., M. L. A., etc.; sacro-left-anterior, etc., S. L. A., etc.; scapular-left-anterior, etc., Sc. L. A., etc.

* Except in face presentations, in which case the chin is chosen on account of its prominence in the mechanism of this variety of labor.

† The older obstetricians were accustomed to recognize four other varieties, in which the occiput was respectively directly posterior, directly anterior, left transverse, and right transverse. It is now held, however, that these positions do not occur, under normal conditions, in normal pelvis. Since they are only found in some varieties of deformed pelvis and in some other pathological conditions, their consideration is now commonly relegated to the domain of pathology.

‡ Dextro.

ANATOMY OF THE PELVIS.

The anatomy of the bones and the soft parts which together make up the pelvis is described in detail in another portion of this work, but for the comprehension of the mechanism of labor it is necessary to add to the anatomical description a discussion of the shape and dimensions of the parturient canal as a whole, before its mechanical relation to the fetus which is to pass through it can intelligently be discussed.

The *parturient canal* (Fig. 211) may be divided, for purposes of description, into three parts—the *suprapelvic*, the *pelvic*, and the *infrapelvic* portions.



FIG. 211.—The parturient canal: AU, axis of uterus; AI, axis of inlet; RR, retraction-ring; IO, internal os; EO, external os (one-third natural size).

The *suprapelvic* or abdominal portion of the parturient canal is made up of the uterine cavity and the large or false pelvis. This portion of the pelvis is classified with the uterine cavity on account of the similarity of their functions; that is, the obstetric function of the large pelvis is simply that of affording a resting-place to the lower portion of the child during the whole or

* The given ar

the greater portion of pregnancy, and of guiding the presenting part to the inlet at the beginning of labor. The *pelvic* portion of the parturient canal consists of the small or true pelvis. The *infrapelvic* portion is made up of the soft parts lying below the pelvic bones, which parts, though small and inconspicuous in the non-parturient state, are stretched out during labor into a tubular canal which considerably prolongs the parturient canal, and completes the curve of its lower portion, known as the *curve of Carus*.

An adequate comprehension of the shape and the mechanical functions of the parturient canal in its entirety will best be attained by postponing the description of the canal as a whole until its subdivisions and component parts have been described in detail.

Suprapelvic Portions.—*Uterine Cavity.*—The uterus at term is a hollow, ovate-shaped viscus, whose cavity, although anatomically a part of the parturient canal, is, from a mechanical standpoint, less a part of the passage than the engine by which the passenger is to be propelled. The function of the uterus as the source of the propulsive power by which labor is accomplished will be discussed later. Its function as a portion of the canal requires no special description.

False Pelvis.—The false or large pelvis is that portion of the pelvis lying above the linea terminalis. It is composed of the lumbar vertebræ, the upper surfaces of the lateral processes of the first sacral vertebra, and the squamous portions of the iliac bones, and functionally it is completed by the lower portions of the anterior abdominal muscles and their attachments to the horizontal rami of the pubic bones. The whole thus forms a funnel whose sloping walls terminate in the inlet of the true pelvis, and are admirably suited to their office of directing the presenting part into the pelvis in the initial stage of labor. Apart from this point, the chief practical value of the false pelvis is in the light which alterations of its shape or of its dimensions throw upon the diagnosis of pelvic deformities. To be in a position to detect any departure from the normal shape of the pelvis, it is especially important to be familiar with the normal shape of the iliac crests and with the normal curve of the linea terminalis.

Although the crests of the ilia are classically described as presenting an S-curve, it must be remembered that only one portion of this curve—namely, that which possesses an anterior concavity—enters into the formation of the basin of the false pelvis; the other portion of the curve is entirely without the pelvis, and is utilized solely for the attachment of the sacro-iliac ligaments and the erector spinæ muscles. The shape of the anterior portion of this curve is such that the greatest distance between the crests is normally 2.5 centimeters (about an inch) more than the distance between the anterior superior spinous processes, the distance between the crests being normally 25 centimeters (about 10 inches), and that between the spines 22.5 centimeters (about 9 inches).*

Under normal circumstances the anterior portion of the linea terminalis

* These dimensions are found to be somewhat variable among different races. The figures given are believed to be approximately correct for American women.

presents a uniform curve with an internal concavity, and there is but little, if any, projection of the crest of the pubes in or about the median line.

Pelvic Portion.—The true or small pelvis comprises all that portion of the pelvis lying below the linea terminalis, and it is divided into three portions—the superior strait or inlet, the inferior strait or outlet, and the excavation. It is formed by the sacrum, the coccyx, the lower portion of the ilia, the ischia, and the pubes. These bones taken together form a deep basin-shaped cavity, whose posterior wall is formed by the sacrum and coccyx and is

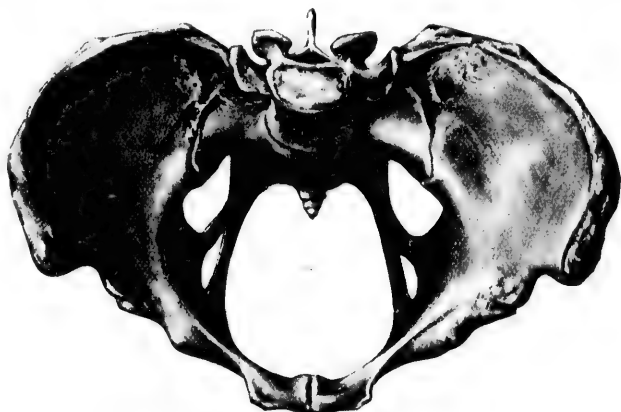


FIG. 212.—Pelvis seen from above, showing the decrease in the transverse diameter from above downward (one-third natural size).

sharply curved with an anterior concavity. The anterior wall is formed by the symphysis, and is short and nearly straight. The lateral walls, which are formed by the lower portions of the ilia, the ischia, and parts of the descending rami of the pubes, are irregular in outline and slope gently inward, so that the transverse diameter of the pelvis is markedly less at their lower than at their upper extremities (Fig. 212).

At its upper and lower limits, which are known as the *superior* and *inferior straits* (Fig. 213), the dimensions of the pelvis are much less than in the intervening space, called the "excavation." An accurate knowledge of this portion of the parturient canal is of the greatest importance, and on account of its complexity is most easily given by separate descriptions of the excavation and of each of the straits, after which description it will be easy to include that of the pelvis as a whole in the general description of the parturient canal that follows at the end of this section.

The *superior strait* is bounded by the promontory and the anterior surface of the first sacral vertebra, the linea terminalis, and the pubic crests. The shape of the inlet or superior strait of the pelvis varies considerably in accordance with the point of view selected, but if the eye of the observer is placed in the probable position of the axis of the child at term, it will be seen that the shape of the inlet is approximately circular (Fig. 212).

It must be remembered that the presence of the soft parts somewhat alters

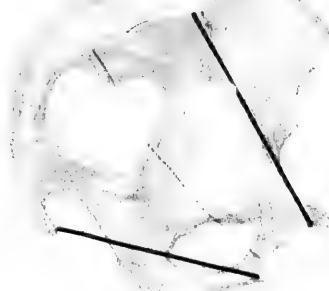


FIG. 213.—Lateral view of the pelvis, showing superior and inferior straits (one-third natural size).

the shape of the brim. The importance of this fact, however, is lessened by

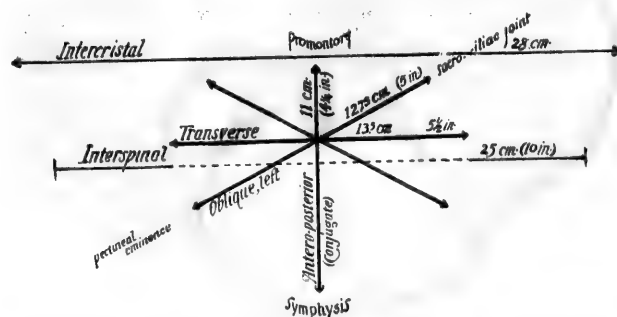


FIG. 214.—Pelvis seen from above, showing diameters of brim (one-third natural size).

the fact that the vessels, the connective tissues, and the rectum, as well as the

psoas-iliacus muscles, which together form the only important soft parts in the inlet, are concentrated in the sacro-iliac notches, where the space is already most abundant and where its decrease is of least importance.

The dimensions of each of the straits are determined by measuring the antero-posterior, the transverse, and the two oblique diameters. The antero-posterior, or, as it is more commonly termed, the *conjugate*, diameter of the superior strait (Fig. 214) extends from the upper border of the symphysis pubis to the promontory of the sacrum; its normal length is 11 centimeters ($4\frac{1}{4}$ inches). A little less than half an inch from the upper border of the symphysis pubis is found a point which, owing to the thickness of the pubic bone, is decidedly nearer to the promontory than the upper border itself. From the promontory to this point the distance is 10 centimeters (about 4 inches), and this is called the "obstetrical" diameter or true conjugate.

The greatest transverse diameter of the superior strait averages 13 centimeters ($5\frac{1}{4}$ inches) in length; this is the diameter referred to whenever the transverse diameter of the superior strait is mentioned. This diameter lies, however, so far back in the pelvis—that is, so near the promontory (Fig. 214)—that it can never be occupied by any of the diameters of the fetal head. The transverse diameter, which could, in fact, be occupied by the fetal head, lies some distance anterior to this, and is so much shorter as to be of little importance, being, in fact, less than are the oblique diameters. In point of fact, the head never enters a normal pelvis transversely, and the transverse diameter is therefore measured merely as a means of comparing one pelvis with another.

The oblique diameters extend from the ilio-pectineal eminences to the sacro-iliac articulations; their length is 12.5 centimeters (about 5 inches). Since the terms *right* and *left* oblique diameter are differently used by different authorities, it seems best to distinguish these diameters as the *first* and *second* oblique diameters of the inlet, in accordance with the frequency of their importance in the mechanism of labor; the first being that which extends from the left ilio-pectineal eminence to the right sacro-iliac synchondrosis.

The *inferior strait* is bounded by the subpubic ligament, the descending rami of the pubes, the rami, tuberosities, and spines of the ischia, the sacro-sciatic ligaments, and the coccyx. Its shape, when looked at in the direction of its axis, is that of a lozenge whose anterior sides are formed of the pubic and ischiatic rami, while the posterior are made up of the sacro-sciatic ligaments.* When looked at from a point somewhat anterior to the line of its axis, it is seen to present a roughly triangular shape; but when we remember that the sacro-sciatic ligaments become very distensible during labor, and that the softening of the sacro-iliac and sacro-coccygeal articulations that occurs

* Owing to the projection downward of the tuberosities of the ischia, it will be seen that the surface of the inferior strait is bent upon itself to form an external convexity (Fig. 215). For practical purposes it is, however, convenient to neglect this bend, and to deal with the inferior strait as though it did, in truth, lie in a plane between the tip of the coccyx and the subpubic ligament.

during pregnancy permits of a considerable movement of these bones upon each other, it will be seen that when the soft parts of the inferior strait are

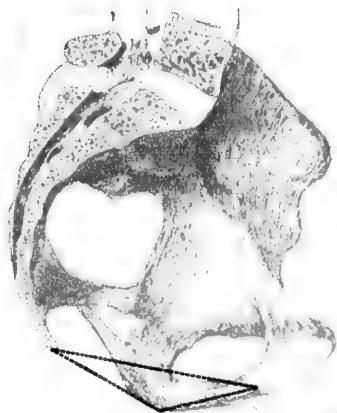


FIG. 215.—Lateral view of the pelvis, showing external convexity of the inferior strait.

distended by the head, its aspect from either position will be that of an ovate or egg-shaped orifice (Fig. 216).

The antero-posterior diameter of the inferior strait extends from the lower border of the symphysis to the extremity of the coccyx. Its length in the non-parturient state is 9.5 centimeters (about $3\frac{3}{4}$ inches), but when the move-

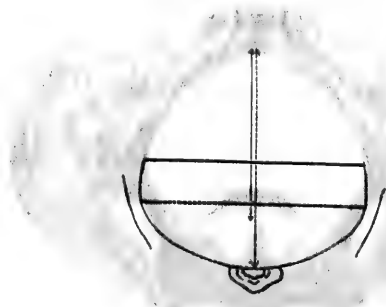


FIG. 216.—View of distended outlet. The dotted lines show the possible position of the sacro-sciatic ligament and the consequent increase in the transverse diameter during extreme distention.

ments of distention spoken of above are fully effected, the length of this diameter is increased to 11.5 centimeters ($4\frac{1}{2}$ inches), or perhaps even to 12.7 centimeters (5 inches).

The transverse diameter, which is drawn between the inner borders of the tuberosities, measures 10.5 centimeters ($4\frac{1}{4}$ inches), and it is the only unyield-

ing diameter of the inferior strait. The divergent direction of the tuberosities makes it possible, however, for the transverse diameter of the head to correspond with a much wider transverse diameter of the outlet whenever the conditions of the case permit the parietal protuberances to occupy a position posterior to the tuberosities (Fig. 216).

The oblique diameters are manifestly rendered unimportant by the uncertainty as to their length, the result of the elasticity of the sacro-sciatic ligaments.†

The excavation, which is bounded by the inferior and superior straits, comprises all that portion of the pelvis lying between them. The backward curve of the bodies of the sacral vertebræ and the straightness and shortness of the anterior wall of the pelvis render the excavation much more roomy in an



FIG. 217.—Diagram showing a division of the lateral wall of the excavation into sections in accordance with their mechanical functions.

antero-posterior direction than is either of the straits, and this increase of space is, of course, greatest in the middle portion of the excavation. The oblique diameters are correspondingly increased for the same reason, and, indeed, in the middle of the excavation they are often longer than any of the diameters of a small fetal head—a fact which is sometimes of importance in the mechanism of posterior positions of the vertex and of presentations of the face.

If the transverse diameters of the excavation were similarly ample, this portion of the pelvis would be devoid of obstetrical interest; but this is far from true. The transverse diameter of the excavation is at one point the smallest and also one of the most rigid diameters of the whole pelvis, and the importance of the anatomy of the lateral walls of the excavation is so great that its comprehension is the key-note to the whole subject of obstetrical mechanism. The anatomy of the lateral walls is so difficult of description that it

is possible to comprehend it only by means of a subdivision of the lateral walls of the excavation into three parts (Fig. 217): An *upper portion (A)*, (Fig. 217), which is roughly triangular in shape; a *second portion (B)*, which lies below and in front of the first; and a *third portion (C)*, which lies below and behind the first.

Portion A is composed throughout of unyielding bone. In its upper part its surface is smooth and very uniformly curved. The transverse diameter of the pelvis at this point is the ample transverse diameter of the superior strait. The oblique lines drawn through the anterior edge of this portion upon one side of the pelvis and through the posterior edge of the corresponding portion upon the other side are likewise ample, and, indeed, vary but little from this same length ($5\frac{1}{2}$ inches). In its lower part *portion A* of the lateral wall inclines inward to its termination in the rigid ischial spines, between the points of which the smallest diameter of the pelvis is found—a diameter so small as to be practically impassable by the biparietal and suboccipito-bregmatic diameters of a full-sized head.

Portion B of the lateral walls of the excavation has but little rigid bone in its composition. Its upper part is made up mainly of the membranous coverings of the foramen ovale, that are covered by the obturator muscle, and at the time of term, like all the other ligaments and fascial coverings of the pelvis, are more elastic than in the non-parturient state. When these muscles and fasciæ are put upon the stretch by the pressure of the presenting part during its descent, their recession converts *portion B* of the lateral wall into a shallow spiral groove, with bony edges and a soft floor, which deepens as it descends and turns forward. The ischio-pubic ramus, which forms the floor of the lower part of *portion B*, is here so curved (laterally outward) as to lend itself readily to the continuation of this groove.

Portion C has a bony edge composed of the posterior border of the ischium and the lateral edge of the sacrum and coccyx, but it is made up mainly of the very elastic sacro-sciatic ligaments and the pyramidal muscle. When these ligaments and muscles are put upon the stretch during the descent of the head, *portion C* of the lateral wall is converted, like *portion B*, into a spiral groove which deepens as it descends and turns forward.

When the rigidity of *portion A* and the yielding nature of *portions B* and *C* are considered in connection with the fact that even in the bony pelvis the foramen ovale and the sacro-sciatic notches are regions of recession separated from each other by the projecting ischial spines, it will be seen that when distended by pressure from within, the lateral walls of the excavation may be considered as consisting, for mechanical purposes, of two deep grooves separated from each other by a prominent ridge of unyielding bone (Fig. 218). The anterior of these grooves pursues a spiral course downward and forward from the anterior end of the oblique diameter at the brim, to end under the pubic arch at the anterior end of the conjugate diameter of the inferior strait. The posterior groove pursues a similar spiral course downward and forward

from the posterior end of the other oblique diameter at the brim, to end in the same point at the anterior end of the conjugate at the outlet.

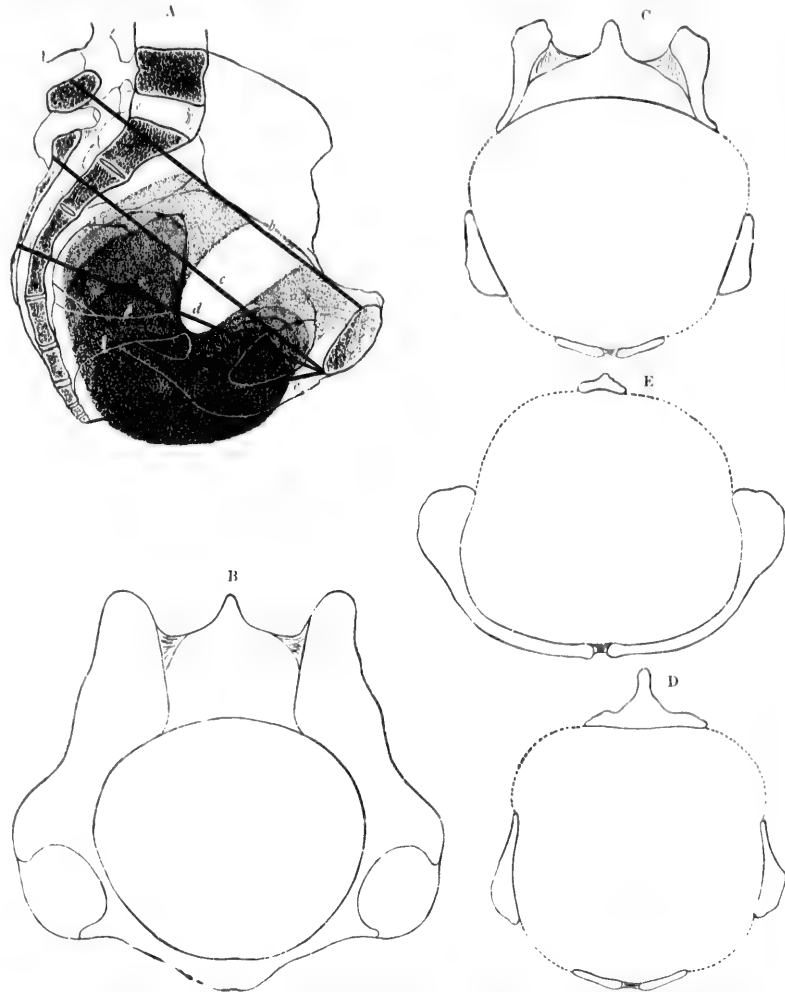


FIG. 218.—Sections of the pelvis, showing the lateral grooves and the bony ridge which separates them: A, sagittal section. The lines *b, c, d, e*, indicate the horizontal planes through which the cross-sections *b, c, d, e*, are taken. The shaded portions of the figure indicate the spiral grooves, the depth of the groove being deepest where the shading is darkest. B, cross-section, showing the nearly-uniform curve of the unbroken bony circumference of the superior strait. C, cross-section, showing the bony ischium (A, Fig. 217) separating the distensible foramen ovale (B, Fig. 217) and sacro-sciatic notch (C, Fig. 217). D, cross-section through the ischial spines, which here emphasize deflection inward of the bony ridge (A, Fig. 217). E, cross-section near the inferior strait. The posterior half is distensible, and in the anterior half the bony descending ramus of the pubes curves outwardly to continue the curve formed by the yielding tissues which cover in the foramen ovale, as seen in the sections C and D.

The oblique diameters drawn toward the bottom of the anterior groove

upon one side and the bottom of the posterior groove upon the other side are throughout the pelvis ample for the passage of any of the diameters of the fetal head except the occipito-frontal and the occipito-mental. Should any round body be started at the upper end of either of these grooves, and be forced downward by a *vis-a-tergo* under the influence of a constant intrapelvic pressure, it must necessarily follow the path of least resistance—that is, the course of the groove in which it started—to end its course under the pubic arch at the outlet. The importance of these considerations will be apparent when the section on the *Mechanism of the Second Stage of Labor* is reached.

Infrapelvic Portion.—When the soft parts below the inferior strait are distended by the head, they include a hood-shaped space of considerable size, bounded upon its upper border by the edge of the pubic arch, the tuberosities of the ischia, and the lower edge of the sacro-sciatic ligaments, and upon its other or inferior border by the orifice of the distended vagina. Its anterior wall is from a quarter to half an inch in length. Its posterior wall, when fully distended, is from 6 to 10 centimeters ($2\frac{1}{2}$ to 4 inches) in length.

When the head has wholly escaped from the inferior strait it occupies an elastic canal composed wholly of soft parts and having but one mechanical function—an elasticity which keeps the head constantly in contact with the edge of the pubic arch.

The Parturient Canal as a Whole.—The parturient canal (Fig. 211) consists functionally of two portions, an ovate reservoir formed by the uterine cavity and the false pelvis, and a curved passage which extends downward and forward from the lower opening of the reservoir. This passage possesses an irregularly cylindrical shape which has classically been likened to the curve of a ram's horn. The anterior wall is much shorter than the posterior. If both the anterior and posterior walls are divided into an equal number of equal parts, and planes are drawn between each pair of these points (Fig. 219), a curved line passing through the centre of each of these planes forms what is known as the *axis of the pelvic canal*; if this curved line is continued forward, it will reach the abdomen of the mother at about the situation of the umbilicus in the non-parturient state. This prolongation of the pelvic axis is known as the *curve of Carus*.

The centre of any body passing through the pelvic canal must travel through a path closely approximate to this curved axis. Were the pelvic canal exactly cylindrical and the fetal head exactly spherical, the mechanism of labor would be limited to an observation of the above-related fact; but in reality the irregularities in the contour of the pelvic canal and the corresponding irregularities in the shape of the fetal head are matters of the greatest importance. It will be remembered that although the transverse diameter of the superior strait is nominally the greatest, yet the rapid convergence of the ilio-pectineal lines as they stretch forward renders the length of the practicable transverse diameter in fact less than that of the oblique diameters, so that any ovate body presented to the inlet of the pelvis will tend to enter the brim in the oblique diameter.

At the inferior strait the transverse diameter is the narrowest of the whole

pelvis, and, since the oblique diameters at the moment of delivery are shorter than the distended conjugate, any ovate body which attempts to pass the outlet will do so most readily if its long diameter corresponds with the antero-posterior diameter of the inferior strait. It is therefore evident that the process of

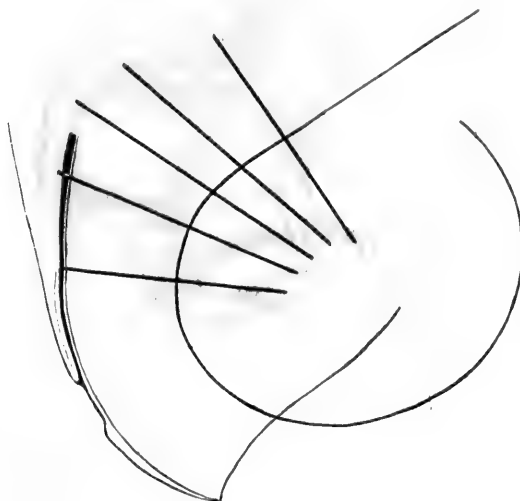


FIG. 219.—Sagittal section of the pelvis, showing the pelvic axis and the curve of Curus.

labor will most easily be accomplished by the occurrence of a rotation of the longest diameter of the presenting parts from an oblique position at the superior strait to an antero-posterior position at the outlet; in point of fact, the mechanical relations which lead up to this rotation lie at the bottom of the whole subject of the mechanism of labor.

It is to be noted that when the woman is in the erect position the axis of the superior strait* forms an angle of about 30° with the horizon; that in the same position of the woman the axis of the inferior strait is directed downward and a little forward; and that the axis of the vaginal outlet of the parturient canal looks almost directly forward and but very slightly downward.

Differences between the Male and the Female Pelvis.—It is important that the obstetrician should clearly understand the normal characteristics of the female pelvis in contradistinction to those of the masculine form, because the approaches to a masculine type—which are not uncommon and may occur in any portion of the pelvis—are not unimportant as a cause of dystocia and

* A line drawn from the centre of the superior strait in a direction perpendicular to its plane.

of alterations in the mechanism of labor. The differences between the male and the female pelvis will be rendered most easily familiar by the use of a series of figures showing respectively the shapes of the superior strait, of the

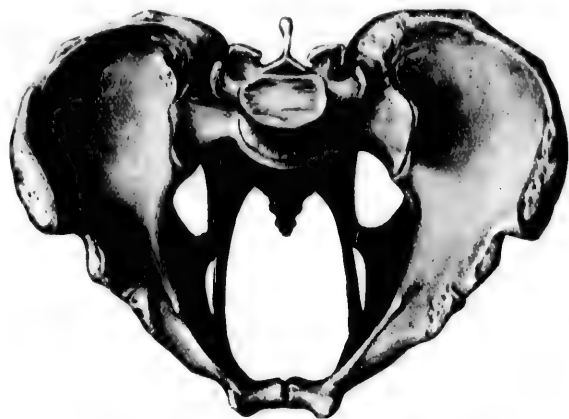


FIG. 220.—Male pelvis viewed in the axis of the brim.

antero-posterior curve of the sacrum and the pubic arch, and of the inferior strait in the masculine and feminine types.

Superior Strait.—In the male the sacrum is narrow, the promontory encroaches deeply into the brim, the iliac crests are comparatively erect, and the interior concavity of the anterior portion of the ilio-pectineal line is but little

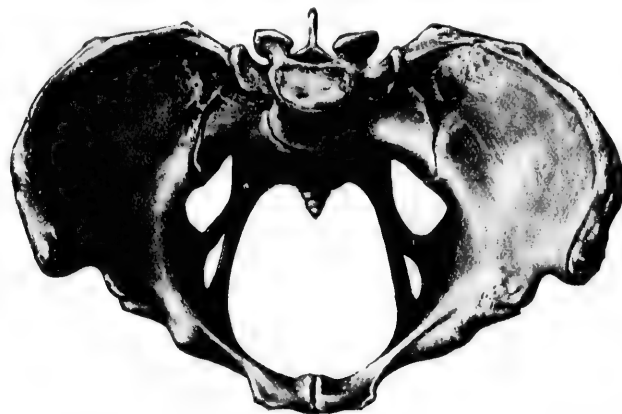


FIG. 221.—Female pelvis viewed in the axis of the brim.

marked (Fig. 220). The shape of the inlet is thus angular and strongly cordate as compared with that of the female pelvis (Fig. 221).

Antero-posterior Section of the Pelvis.—In the male the sacrum is long and

its upper portion is nearly straight, while the lower part of this bone and its continuation, the coccyx, are bent sharply forward. The symphysis and the adjacent portions of the descending rami are long and erect (Fig. 224). In the



FIG. 222.—Male pelvis seen from the front.

female (Fig. 225) the sacrum is shorter, its general direction is more distinctly downward and backward, its upper portion is much more concave from above downward, and the antero-posterior curve is throughout more uniform than in



FIG. 223.—Female pelvis seen from the front (one-third natural size).

the male. The symphysis is short, and the wider pubic arch, shortly to be spoken of, decreases the importance of the descending rami in the formation of the anterior wall.

Inferior Strait.—In the male (Fig. 222) the angle of the pubic arch meas-

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ures from 75° to 80° . The anterior wall of the pelvis—that is, the distance between the symphysis and the tuberosities—is long as compared with the pelvis of the female (Fig. 223), in which pelvis the sides of the pubic arch form an angle of from 90° to 100° , and the entire depth of the pelvis is much diminished. The backward recession of the tip of the sacrum and the coccyx, together with the increased distance between the tuberosities, greatly

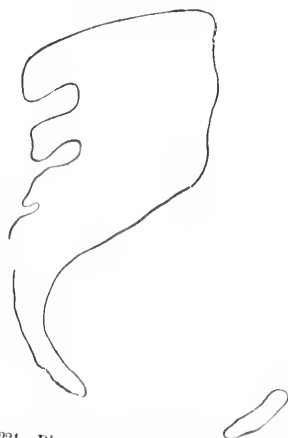


Fig. 224.—Diagrammatic antero-posterior section of male pelvis.

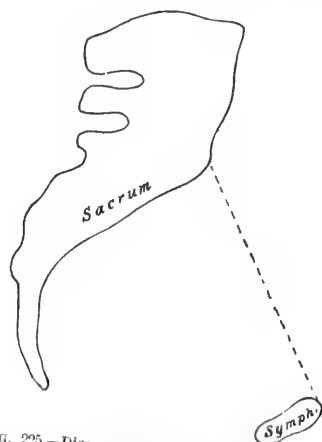


Fig. 225.—Diagrammatic antero-posterior section of female pelvis.

increases the size of the inferior strait in the female (Fig. 221) as compared with the male (Fig. 220). There is a greater relative distance between the acetabula, and their surfaces are directed somewhat obliquely to the front. This situation of the acetabula is decidedly unfavorable to the function of the hip-joints in locomotion, and it accounts for the greater proximity of the knees in women and for the characteristic difference between their gait and that of men, whose pelvic bones are designed for locomotion alone. X

THE FETUS.

The head of the new-born child is, proportionately to its body, so much larger than that of the adult, and the body is proportionately so much the more compressible, that the head is in most cases the only part of the body that affords any considerable mechanical obstacle to the passage of the fetus through the parturient canal. From its comparative incompressibility it is, moreover, the part which most nearly retains its normal shape throughout labor, and it is therefore in the passage of the head that the mechanical processes of labor are most plainly marked and most important.

From the foregoing considerations it is at once apparent that a thorough familiarity with the dimensions and shape of the fetal head and with the changes it undergoes during labor is a necessary preliminary to the comprehension of the principles of obstetric mechanism. Some familiarity with the

shape and dimensions of the remainder of the fetus in the attitude it ordinarily assumes, though less often of importance, is nevertheless essential.

The Fetal Head.—The head is obstetrically divided into two portions, the *face* and the *cranium*.

The *face* is much smaller in proportion to the cranium than that of the adult, and is of but little importance in normal labors. It is, however, well to remember that the face is made up of the most solid and incompressible bones which enter into the composition of the head, and that its configuration is altered but little, if at all, by the processes of labor.

The *cranium* or *brain-case* is to be divided for purposes of description into two portions, the *base* and the *vault* of the skull. The base is formed by the basilar portion of the occipital bone, the petrous portions of the temporal bones, the sphenoid and ethmoid, and the orbital processes of the frontal bones. These bones, even at birth, are firmly united, and they form a comparatively small but almost totally incompressible mass. The vault is made up of the parietal bones and the squamous portions of the occipital, temporal, and frontal bones. These bones are all wide, flat, and slightly curved. The squamous portion of the occipital bone is attached to the basilar portion by a band of fibro-cartilaginous tissue which permits of quite free motion between the two portions. All the bones of the vault are united at their edges by membranous commissures formed of the dura mater and the unossified external periosteum. The vault of the cranium, though much larger than the base of the skull, differs from the base in its possession of compressibility and of a marked capacity for alteration of shape under the moulding influences of the constant pressure of labor. It must be remembered, however, that different heads present very different degrees of ossification at the time of birth, and, indeed, vary widely, from cases in which the flat bones are so slightly ossified as readily to be bent by the pressure of the finger, and in which the membranous intervals are extremely wide and well marked, up to cases in which

the ossification and union of the bones are so far advanced as to reduce the compressibility of the skull to a minimum of small practical value.

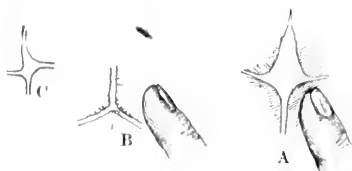
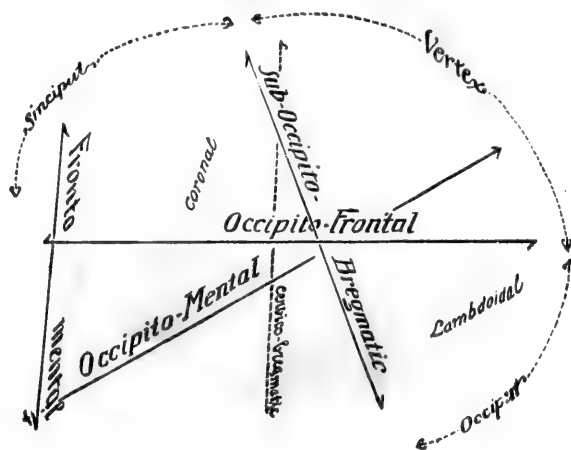


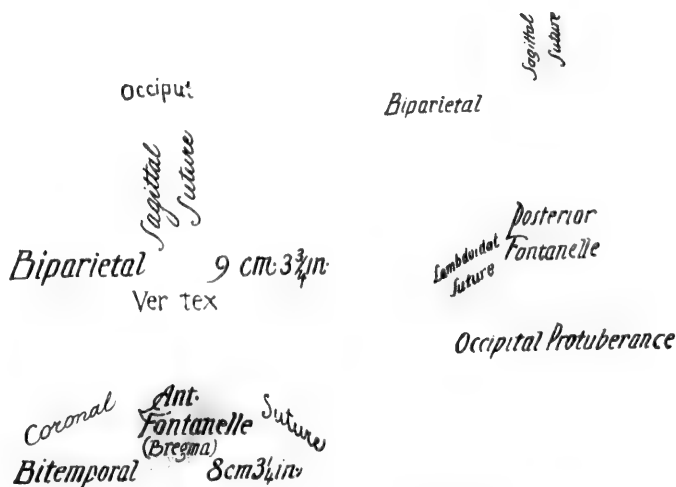
FIG. 226.—Diagrams of the fontanelles: A, anterior; B, posterior; C, lateral.

membranous spaces known as *fontanelles* (Fig. 226). The sutures are distinguished by the following names: That between the frontal bones is the *frontal*; that between the frontal and parietal bones is the *coronal*; that between the parietals is the *sagittal*; and that which separates the squamous portions of the occipital from the two parietals is the *lambdoidal* suture.

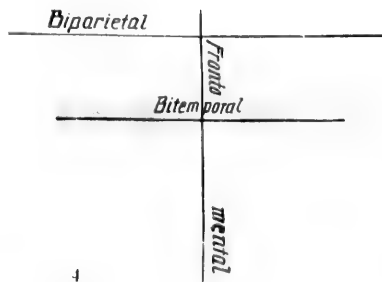
At the point where the frontal and parietal bones come together the frontal,



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FETAL HEAD: 1. Fetal skull seen from the side; 2. Fetal skull seen from above; 3. Fetal skull seen from behind; 4. Fetal skull seen from in front—showing sutures, fontanelles, and diameters.

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sagittal, and coronal sutures meet in a membranous space or fontanelle which is rhomboidal in shape and is ordinarily of considerable extent. This space is known as the *anterior* or large fontanelle, and sometimes as the *bregma* (Pl. 28, Fig. 2). Of its four sides, the two anterior are usually the longer, and when this difference is well marked the resulting fontanelle may more properly be said to assume the shape of an Indian arrow-head (Fig. 226, A).

The junction of the sagittal and lambdoidal sutures at the point where the occipital and parietal bones meet forms a small triangular space, known as the *posterior* occipital, or small fontanelle (Pl. 28, Fig. 3). In well-ossified heads this space is frequently small or wanting, and the posterior fontanelle is then represented only by the junction of the three sutures. It is to be remembered, moreover, that when the bones are closely crowded together by the pressure of severe labor, either fontanelle, however well marked, may partially or wholly be effaced for the time by an overlapping of the edges of the bones which bound it. Exceptionally, a locally defective ossification along the edges of the bones may result in the production of either Wormian bones or false fontanelles, both of which are most common in the course of the sagittal suture, and which may result in considerable confusion of diagnosis if the possibility of their existence is not borne in mind.*

Dimensions of the Fetal Head.—The size of the fetal head at term varies greatly with the size of the individual fetus, but, however great this variation may be, the relative proportions between the different parts of the head remain approximately constant, and for the sake of clearness it is usual, in the discussion of general principles, to ignore this variation of size and to use as the basis of argument the dimensions of the average head. The diameters that have been found most useful in the description of the head are as follows: The *antero-posterior diameters*—the occipito-mental, the occipito-frontal, the suboccipito-bregmatic; the *transverse diameters*—the biparietal, the bitemporal, and the bimastoid; the *vertical diameters*—the fronto-mental and the cervico-bregmatic.

Antero-posterior Diameters.—The occipito-mental diameter (Pl. 28, Fig. 1) is drawn from the chin to the most distant portion of the occiput. The occipito-frontal (Pl. 28, Fig. 1) is drawn from the point of union of the supraorbital ridges to that portion of the occiput which is most distant from them. The suboccipito-bregmatic (Pl. 28, Fig. 1) is drawn from the point of junction between the occiput and the neck to the centre of the anterior fontanelle.

Transverse Diameters.—The biparietal diameter (Pl. 28, Figs. 2, 4) is drawn from the apices of the biparietal protuberances—namely, through that portion

* It is well to bear in mind, in addition to the anterior and posterior fontanelles, the occasional existence of a third, the *lateral* fontanelle. This fontanelle is present only in poorly-ossified heads, and when present is found at the junction of the occipital, parietal, and temporal bones, near the base of the mastoid process and behind the ear. The lateral fontanelle may sometimes be mistaken for the bregma unless carefully observed. It is four-sided, but is irregular in shape (Pl. 28, Fig. 2). It may be said that the mastoid process feels like the side of a large canine tooth imbedded in the temporal bone. It is usually recognizable, and it is sometimes a valuable point in the diagnosis of this region of the skull.

of the skull at which the lateral surfaces are most widely distant from each other; the bitemporal (Pl. 28, Figs. 2, 4) extends transversely between the most distant portions of the coronal sutures; the bimastoid extends between the mastoid processes at the base of the skull. To these diameters is sometimes added a less important diameter, which is that lying between the base of the zygomatic processes, the bizygomatic.

Vertical Diameters.—The fronto-mental diameter (Pl. 28, Figs. 1, 4) extends from the chin to the upper part of the forehead; in the absence of any distinctive point of origin at its upper extremity, as well as from its small size, it is of but little importance. The cervico-bregmatic (Pl. 28, Fig. 1) is drawn between the junction of the neck and the chin and the centre of the anterior fontanelle.

The lengths of the several diameters, as obtained by Tarnier and Chan-treuil, are given as follows:

	Centimeters.	Inches.
Occipito-mental diameter	13	= 5½
Occipito-frontal "	11.5	= 4½
Suboccipito-bregmatic diameter	9.5	= 3¾
Biparietal diameter	9.5	= 3¾
Bitemporal diameter	8	= 3¼
Bimastoid diameter	7.5	= 3
Fronto-mental diameter	8	= 3¼
Cervico-bregmatic diameter	9.5	= 3¾

These diameters may be divided into classes in two ways: (1) by their compressibility, and (2) by the degree of difficulty with which they may be expected to pass the pelvis. The compressibility of the fetal head as a whole is not only a very variable factor, but the different parts of the same head vary widely in both the ease and the safety with which compression can be applied to them.

The biparietal and bitemporal diameters are safely and easily compressible. The suboccipito-bregmatic, occipito-frontal, and occipito-mental diameters are almost equally compressible, but the degree of danger to the fetus that compression of these diameters involves is vastly greater than is the case with the biparietal and bitemporal diameters; and with oblique compression the degree of danger increases as the direction of the force approaches to the antero-posterior diameters. The bimastoid and bizygomatic diameters are for practical purposes totally incompressible.

The Relative Value of the Diameters of the Head as Compared with the Diameters of the Pelvis.—It will be observed that the lengths of the suboccipito-bregmatic and biparietal diameters are nearly equal, so that a cross-section of the head through these diameters (Fig. 227, A) is very nearly circular; and from this fact and from their size this cross-section is capable of passing any diameter of the pelvis when presented to it in any obstetrical position. Since this is the cross-section which is always presented to the pelvis by well-flexed heads, the study of position would be of little importance if the existence of flexion could always be depended upon and if the remainder of the

head could be neglected; but two factors in labor equally contribute to render this cross-section of the head by no means the only one which must be considered. In the first place, we must be prepared to consider the mechanism of brow and face cases, and, in addition, those cases of vertex labor in which the flexion of the head is, from one cause or another, imperfect; and, moreover, even in the best vertex labor good flexion is seldom attained in the early stages

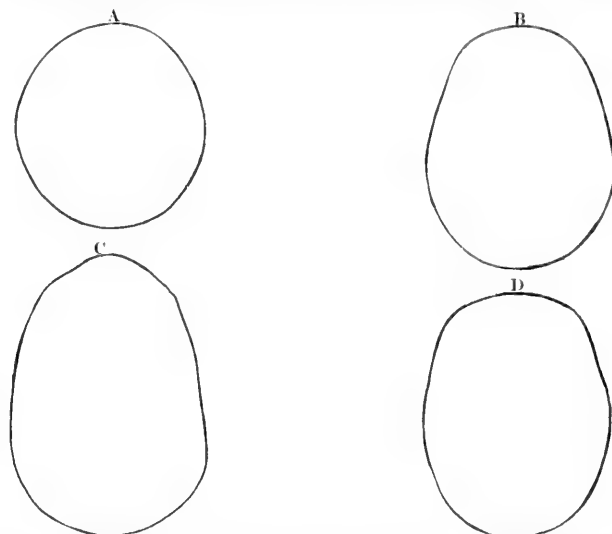


FIG. 227.—Diameters of the fetal head: A, cross-section of the fetal head through the suboccipito-bregmatic and biparietal diameters; B, cross-section of the fetal head through the biparietal and occipito-frontal diameters; C, cross-section of the fetal head through the biparietal and occipito-mental diameters; D, cross-section of the fetal head through the suboccipito-frontal and bitemporal diameters.

of engagement at the brim. Secondly, even when good flexion is present and this circular cross-section is in the inferior strait or excavation, the brim is occupied by the frontal portion of the head in combination with the neck—a by no means unimportant factor in the mechanism of even the most normal cases.

It is therefore important to remember the shape and dimensions of the cross-sections, which include, first, the biparietal and occipito-frontal diameters (Fig. 227, B); second, the biparietal and occipito-mental diameters (Fig. 227, C); third, that which cuts the head and neck through what might be called the "suboccipito-frontal" diameter* and the bitemporal diameter (Fig. 227, D). If the diameters of these cross-sections be compared with those of the pelvis, it will be seen that all the transverse diameters are capable of an easy passage through any of the diameters of the pelvis. The occipito-frontal and suboccipito-frontal are too large to pass any of the conventional † diameters except the oblique diameters at the superior strait and the distensible antero-posterior

* Approximately the cervico-bregmatic plus the thickness of the neck.

† Those which have names.

diameters of the inferior strait; while the occipito-mental is too large even for these, and may consequently be regarded as an impracticable or impossible diameter.

A careful remembrance of the relative values of these diameters will be found of great service in the comprehension of normal labor, and of still more value in understanding abnormal labor.

The Articulations between the Head and the Spinal Column.—The articulations by which the head is joined to the trunk are, it will be remembered, the occipito-atlantoid, the atlanto-axial, and those between the other cervical vertebrae. The occipito-atlantoid articulation admits of but little motion except that of extension and flexion, while even that motion, when carried to extremes, is greatly assisted by a similar movement in the other cervical articulations. So, too, the rotatory movement which alone is possible in the atlanto-axial joint is greatly assisted by the movements in the other articulations of the neck. The capacity for lateral flexion resides wholly in the intervertebral articulations and is limited by their ligaments. Rotation of the head to either side is safely possible only through an arc of about 90° ; that is, when the chin of the fetus is in the plane of the shoulders the limit of safety in rotation has been reached. Antero-posterior flexion is limited only by contact between the chin and the breast. Extension can be carried to a point at which the occiput rests against the back of the neck and the chin is in a line with its anterior surface.

The Fetal Body.—The compressibility of the fetal trunk renders impossible and worthless any statement of the absolute length of the diameters which the fetal body presents to the pelvis during labor; but the relative lengths of the transverse and antero-posterior diameters as compared with each other is of importance, and is constant in at least two parts of the trunk—namely, in the regions of the shoulders and the hips. The transverse diameter in both these regions is always longer than the antero-posterior diameter.

The Shoulders.—The relation of the shoulders of the infant to the mechanism of labor is somewhat altered by their movability. The shoulders may be presented to any portion of the pelvis in one of two positions: First, they may enter together, with the line of the clavicles approximately at right angles to the spine—that is, in the position ordinarily assumed by adults. Second, one shoulder may be elevated and the other depressed, so that the one enters in advance of the other, both clavicles being still approximately in the same line, but this line now forming an oblique angle with that of the vertebral column. In the second, which is the usual and normal position, the transverse diameter never loses its superiority of length over the antero-posterior diameter. When both shoulders enter together, this superiority of the transverse diameter is always somewhat less marked, and is occasionally so much diminished as to lead to interruptions of the mechanism by which the delivery of the shoulders is normally accomplished.

The Hips.—The pelvic bones of the infant are sufficiently rigid to prevent any considerable moulding of the breech, and the transverse diameter of the

hips is always considerably greater than the antero-posterior diameter of the same portion of the body.

The Trunk.—The intermediate portions of the infant's trunk are so soft and compressible that its diameters are totally inconstant. The shape of the cross-section of the trunk corresponds with the shape of that portion of the pelvis in which it lies, and even the presence of the limbs in juxtaposition with it makes but little difference, since its softness permits the limbs, under the pressure of labor, to indent it at any point.

DIAGNOSIS, FREQUENCY, AND PROGNOSIS OF THE SEVERAL VARIETIES OF LABOR.

DIAGNOSIS.*—In obstetric diagnosis we are furnished with two methods of examination of almost equal importance—namely, examination of the abdomen and examination of the vagina—which must be described separately.

The abdominal examination must be subdivided into inspection, palpation, and auscultation. In the use of this method of examination it is best for the beginner to ignore the possibility of O. L. P. and O. D. A., on account of their great infrequency and of the excessive complications that an effort at their recognition would involve.

The value which the individual obstetrician places upon an abdominal examination is generally proportionate to the experience he has enjoyed. The beginner should be urged to avail himself of every opportunity for practising this method, for, while he will find in his early practice many cases in which the obesity of the patient or the rigidity of the abdominal muscles and uterus renders abdominal palpation of no value, a large number in which the examination is inconclusive, and only a few in which he can attain a clear diagnosis by this means, yet as his experience enlarges the first class will steadily decrease in number and the latter two will increase proportionately, if he is faithful in practising palpation upon every case that comes under his charge; and the value which attaches to facility in making a diagnosis by this means in many difficult operative cases can be appreciated only by those who possess it. It is certainly a fact that to the experienced hand abdominal palpation yields results fully as valuable as those which can be obtained by digital examination per vaginam, and that there are but few cases in which repeated examinations during the progress of labor will fail to establish a diagnosis by palpation and auscultation alone.

Abdominal Inspection.—Inspection is mainly valuable as affording a hint of the existence of transverse presentations and of multiple pregnancy.

Abdominal Palpation.—Palpation is the most important part of the abdominal examination; it should be performed only in the intervals between the pains, all pressure of the hand being intermitted with the appearance of

* Although the methods which must be used in making the diagnosis of presentation and position are indicated in another part of this work, such a diagnosis is so essential to the mechanical management of labor that it seems wise to repeat the technique of the several methods of examination in this section.

each contraction. The physician should stand by the patient's side facing toward her head, and should apply the palm of each hand flat against the corresponding side of the uterus. Throughout the examination it is all-important that the motions of the hand should be slow and gentle, any quick or jerky impulse being almost certain to result in rigidity of the abdominal walls and the uterus, thus frustrating the purpose of the examination. Every effort should be made to divert the attention of the patient, to soothe her fears, and to assure her that the examination will not be painful. It not infrequently happens that the first attempt will be a total failure, while the second will yield satisfactory results owing to the changed mental condition of the patient.

Diagnosis of Presentation by Palpation.—The finger-tips of each hand should be pressed with a gradual and gentle motion downward behind the symphysis pubis in search of the fetal head (Fig. 228), which in cephalic pres-



FIG. 228.—Diagnosis of presentation by palpation.

entations is almost always to be felt in this situation as a marked transverse check to the examining hand. In this examination care should be taken to note on which side the head is most plainly perceived, since with a well-flexed head the frontal extremity is much the more easily reached, with the partially extended head but little difference is to be noticed, and in face presentations the occiput is much the more distinct.

The fundus should then be palpated carefully as a further means of excluding the possibility of a breech presentation. The head may be distinguished from the breech at the fundus by its greater size and mobility, by its rounded contour as opposed to the tapering form of the smaller breech, and by an easily distinguished sulcus which corresponds with the neck of the child; but the best evidence of the presence of the breech at the fundus

is always the recognition of a head presentation by deep palpation behind the symphysis.

Differential Diagnosis of Presentations by Palpation.—*Cephalic Presentations.*—The most distinctive sign of head presentations is to be found in the recognition of the head by deep palpation behind the symphysis. The diagnosis should then be checked by ascertaining the absence of the signs characteristic of the head at the fundus.

Pelvic Presentations.—In breech presentations the obstetrician's attention is generally first arrested by the absence of the transverse check to the fingers, due to the presence of the head, on deep palpation behind the symphysis. He should then be able to recognize the presence of the head at the fundus by the signs just enumerated.

Transverse Presentations.—In transverse presentations the long axis of the child is felt to be transverse. The differential diagnosis between the head and the breech is always of importance, and is to be made by the signs enumerated above as characteristic of the head.

Diagnosis of Position by Palpation.—The hands should be placed along the sides of the uterus and should make gentle but deep pressure toward each other (Fig. 229)—that is, with the uterus and child directly between their



FIG. 229.—Diagnosis of position by palpation.

palms—in the effort to estimate the relative resistance afforded by the right and left sides of the uterus, the flat, firm back of the child usually presenting a resistance to pressure that is markedly greater than that of the yielding abdomen and the movable limbs.

The differing resistances having been estimated, the fingers should be applied to the sides of the uterus, not with the tips deeply indented into the abdomen, but with their whole palmar surface pressed firmly against the

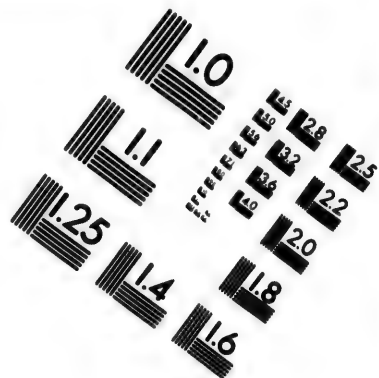
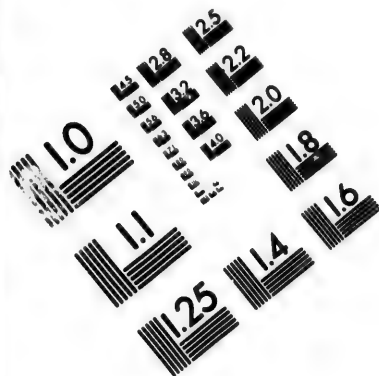
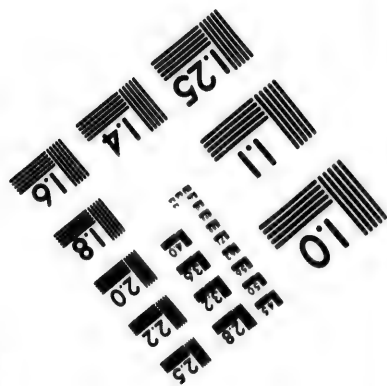
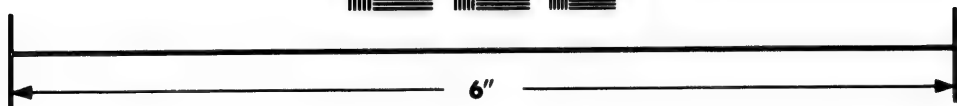
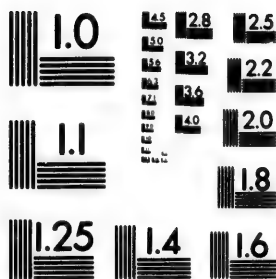


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uterus; the hands should then be moved gently up and down along the uterine wall in an endeavor to recognize the irregularities due to the presence of the fetal limbs. During this search it is necessary to guard against the error of mistaking either of the round ligaments for the fetal members. These ligaments, which at term are of nearly the size of the adult finger, extend obliquely from the cornua of the uterus downward, outward, and forward to the pelvic brim. They may be recognized by their situation and by the pain of which the patient invariably complains when they are rolled about under the fingers. The existence of small subperitoneal fibroids is another possible source of error. With thin and flaccid abdominal walls it is sometimes possible by this method to recognize the fetal limbs with the utmost distinctness, but in the majority of cases an irregularity in the contour of the fetus is all that can be hoped for.

By palpation, then, we can hope to distinguish not only the presentation, but also the position, since the latter must correspond with the quarter of the pelvis in which the fetal back is found. Owing to the infrequency of O. D. A. and O. L. P. positions, it is generally safe to call all cases in which the back of the child is found toward the left, O. L. A., and those in which it is found toward the right of the mother, O. D. P.

Abdominal Auscultation.—Auscultation of the fetal heart gives confirmatory evidence about the presentation and position, informs us of the condition of the child, and is the most important sign in the recognition of multiple pregnancy.

In vertex presentations the heart is most plainly heard over the back of the child and below the mother's umbilicus;* in breech presentations the heart is heard over the back, but its greatest intensity is generally above the mother's umbilicus; while in presentations of the face it is most readily heard over that portion of the uterus which corresponds with the chest of the child, but is again below the umbilicus. In transverse presentations the heart is usually plainly audible when the back is anterior, but is often found with difficulty in the posterior varieties, and is of comparatively little value in the diagnosis of position.

In interpreting the evidence of position furnished by the situation of the fetal heart it must not be forgotten that, owing to the fact that sound is better conducted by solids than by liquids, the exact situation of the fetal heart-sounds corresponds with that portion of the back or chest which happens at the moment to be in contact with the uterine wall; the situation of the fetal heart-sound, therefore, may vary temporarily with the position of the mother, as one or the other shoulder rests against her soft parts, or it may temporarily be absent (especially when the patient lies upon her back), owing to the intervention of the liquor amnii between the fetal chest and the physician's ear.

* Owing to the oblique position which the shoulders normally occupy, the dividing-line between the right and the left position of the heart-sounds in this and in all longitudinal presentations should be that drawn between the umbilicus and the right anterior superior spine of the ilium rather than the median line of the body.

In addition to the value of auscultation in the diagnosis of position, its importance in the recognition of the condition of the fetus can hardly be over-estimated, any fatigue of importance being quickly shown by alteration of the rate and regularity of the heart-sounds. In addition to the fetal heart-sounds, the so-called "uterine" or "placental souffle" is generally heard as a soft blowing sound synchronous with the mother's pulse; this sound is of no practical value.

Summary of Diagnostic Signs furnished by the Abdominal Examination.—At the conclusion of the abdominal examination its results should be summed up and a diagnosis be made by some such mental process as the following:

The first process of palpation, described on page 409, enables one to determine whether the presentation is cephalic, pelvic, or transverse, and this result is checked by the position of the fetal heart as obtained by auscultation; that is, in cephalic presentations the heart is found below the umbilicus, in breech presentations above it, and in transverse presentations a little toward that side of the abdomen to which the head is directed.

The position is determined by the situation of the fetal back, as established by the second method of palpation, described on page 409, and by the position of the fetal heart, which position should correspond with that of the fetal back.*

If the presentation is either breech or transverse, no further determination is necessary, or indeed possible, by the abdominal examination; but if the presentation is cephalic, it is both necessary and possible to determine whether it is a presentation of the vertex, the brow, or the face. In vertex presentations the end of the head that corresponds with the fetal abdomen—that is, the face—is found at a higher level than the opposite or occipital end, and the fetal heart is heard over the back. In face presentations the end of the child's head that corresponds with the abdomen—that is, the face—is palpated less readily than the dorsal (occipital) end of the head, and the heart is heard over the front of the child.†

In brow presentations both ends of the head are easily reached by palpation. The heart is usually heard over the back.

Vaginal Examination.—*Technique of the Examination.*—In obstetric work it is usually best to avail one's self of the extra length of the middle finger by employing two fingers for all examinations, except in those cases in which the extremely narrow vulva of a primipara makes the introduction of the second finger painful to the patient. Most American obstetricians prefer to

* Except in face presentations (see p. 459).

† It will be perceived that the distinction between vertex and face presentations by abdominal examination is likely to be difficult, since in a left anterior position of either presentation the most accessible end of the head will be found in the right posterior quarter, while in both presentations the heart is left anterior; the only distinction is to be found in the position of the fetal limbs as compared with the heart, and in the perception of the greater size and more rounded contour of the occiput as opposed to the face; but the great infrequency of face presentations and the ease with which they are distinguished on vaginal examination make this source of error a matter of small importance.

examine the patient when in the left lateral decubitus, but it is well to accustom one's self to examining in all positions, not only in the interest of the patient's comfort and convenience, but also because it is often possible by changing the decubitus to reach a portion of the child that has before been unattainable.

The vulva being aseptic, the hand, having been thoroughly disinfected and anointed with an aseptic lubricant, should be introduced under the bed-clothes, which should be so held up by the other hand as to protect them from contact with the examining fingers; these should be placed against the genital cleft, and be swept gently forward until they find the entrance of the vulva and come in contact with the fourchette, friction against the vestibule and clitoris being carefully avoided in the process.

As the examining finger enters the vagina it should note successively the size of the vulvar orifice, the position of the coccyx, the shape of the sacrum,* and the condition of the rectum—whether full or empty. These points having been ascertained, the finger should be passed upward into the posterior fornix, and be swept forward over the soft and yielding vault of the vagina in the effort to find the external os, which is usually situated in the median line and near the centre of the pelvis. In case of failure to find the os readily, the field of the pelvis should be quartered systematically by the examining finger, much after the fashion employed by a pointer dog in searching a field for game. If the cervix be not yet taken up, it is recognized as a rounded prominence, on the summit of which is found the orifice of the os if the patient be a primipara; in multiparae the lacerated and ragged condition of the cervix frequently makes the external os indistinguishable from an early stage of labor, but the finger in such cases may usually be passed into the cervical canal, and will then recognize the presence of the internal os. If the cervix has been wholly taken up, the os is best recognized by passing the finger through it and into the space between the cervix and the presenting part.†

The physician's ability to reach the upper portions of the pelvis is more dependent upon the position in which his hand is held than upon the length of his fingers. When he desires to reach the upper and posterior parts of the pelvis, his hand should be held in the position indicated in Figure 230, the perineum being strongly retracted by the pressure of the web between the second and third fingers. When the object sought for lies nearer the anterior wall of the pelvis, the position of the hand should be altered by rotation of the forearm into the position represented in Figure 231. The upper border of the second finger is now pressed firmly against the edge of the pubic arch, and the pulp of the finger is directed anteriorly.

* The writer strongly recommends the practice of roughly measuring the conjugate diameter by reaching upward for the promontory of the sacrum, as a routine measure, at the conclusion of the first examination in each case, and he believes that many operative difficulties may be avoided by this simple procedure.

† Unless this precaution of hooking the finger about the edge of the os be observed, the beginner is liable to mistake a fold of the vaginal wall, or in breech presentations the anus, for the os uteri, both of which mistakes have been made by medical students in the presence of the writer.

The os having been reached, the finger should note its size, the thickness of its edge, and its consistency, whether hard or soft, and by very gentle stretching should endeavor to ascertain its degree of dilatability; in this last manœuvre it is necessary to employ the greatest gentleness in order to avoid the inex-



FIG. 230.—Position of the hand in digital examination of the fetus along the posterior wall of the pelvis.

usable accident of a manual laceration of the os during examination. The characteristically different sensations yielded to the finger by the smooth and velvety cervix, the rough but slippery membranes, and the hairy scalp is a matter with which it is important to become familiar, for it is easy to recognize



FIG. 231.—Position of the hand in digital examination of the fetus along the anterior wall of the pelvis.

these differences if the physician has trained himself to observe them in even a comparatively small number of cases, and the possession of this faculty may at some time preserve him from the dangerous or even fatal error of making an application of the forceps to the intact membranes or over an undilated cervix.

If the cervix is thin, it may be possible to recognize the presenting part

through its substance; but in ordinary cases it is necessary to introduce the finger through the os in order to distinguish between the different parts of the child. The finger should be passed up until it comes in contact with the presenting part, and it should then seek systematically for marks by which the character of this part can be determined. The presence of the head is to be determined by the perception of one or more sutures; that of the face, by the presence of the mouth and nose;* that of the breech, by the recognition of the spinous processes of the sacrum, the genitals, and the anus. The tuberosities of the ischia and the pubic arch are also easily recognizable. The shoulder presents no very distinctive marks, and the diagnosis of a transverse presentation is not easily made by vaginal examination during the early stages of labor unless a hand and an arm are prolapsed, but it should always have been recognized by abdominal palpation before the vaginal examination is made. The various distinctive marks of each of the presentations must be sought for, and the diagnosis is to be made in accordance with those found to be present.

Summary of Signs of each Presentation.—The diagnosis of presentation by vaginal examination, though ordinarily easy, is sometimes difficult when the presenting part is still high in the pelvis. It would be supposed, *a priori*, that the distinction between the hard head and the yielding breech could be made in all cases with the greatest ease, but a considerable experience in the superintendence of students has convinced the writer that this point of consistency is a most unsafe and unsatisfactory guide, and some personal experiences have led him to adopt the rule of never permitting himself to diagnose a head unless it is possible to recognize at least one suture, nor to commit himself to the diagnosis of a breech without inserting the examining finger into the anus and recognizing the presence of the coccyx.

Vertex Presentations.—In vertex presentations the finger should first recognize the convergence of the lambdoidal and sagittal sutures forming the small fontanelle. The finger should then pass along the sagittal suture until it reaches the large fontanelle and recognizes the four sutures which enter it. It should next search for the ears, the mastoid processes, and the lateral fontanelles, all of which may usually be found by following the lambdoidal sutures to their terminations. The ear is always recognizable, the mastoid and the lateral fontanelles are less constantly conspicuous, and all these marks are usually less easily reached upon the posterior than upon the anterior side. The ear, when reached, always points toward the occipital end of the head, unless, as sometimes happens, it is folded forward against the scalp—a fact which is easily recognized if the finger is passed backward and forward a few times across the ear. With a well-flexed head the posterior fontanelle is lower in the pelvis than is the bregma, and the upper and posterior part of the ear is generally the more easily accessible. When the head is somewhat extended the fontanelles are upon about the same level in the pelvis, and the anterior edge of the ear is most easily reached. With extreme extension of a vertex presentation the

* Care must be taken not to mistake the supraorbital ridges of a face presentation for the suboccipital ridges of a well-flexed vertex presentation.

eyebrows are not infrequently accessible (see *Brow Presentations*). The diagnosis of position in vertex presentations is made by ascertaining the position of the occiput; this is obtained, first, by comparing the positions of the small and large fontanelles in the pelvis, and, second, by observing the direction in which the flaps of the ears point.

Brow Presentations.—When the extension is so extreme that the small fontanelle is reached with difficulty and the supraorbital ridges and the bridge of the nose are well below the brim of the pelvis, the presentation is that of a brow. By very high examination the mouth can occasionally be touched in brow presentations. The position is named after the position of the small fontanelle, but care should be taken to check the diagnosis by an independent observation of the root of the nose, which should, of course, be in the opposite quarter of the pelvis.

Face Presentations.—When the supraorbital ridges are found upon one side of the pelvis and the point of the chin upon the other, the presentation is a face. Before the diagnosis is considered assured the fingers should recognize, in addition to the chin and the supraorbital ridges, the mouth, the nostrils, the eyes, and the root of the nose in their proper positions; and it is even well to adopt the precaution of always inserting the finger into the mouth and ascertaining the presence of the maxillary processes and the tongue, which can be mistaken for nothing else. The position is indicated by the position of the chin, and should be checked by an observation of the position of the frontal suture.

Breech Presentations.—In breech presentations we must distinguish, during the vaginal examination, between presentations of the whole breech and footling presentations. In presentations of the whole breech the finger should recognize the spinous processes of the sacrum, the anus, and the genital cleft. In boys the scrotum often becomes enormously distended, and this may lead to confusion if the possibility of the fact is not borne in mind. When a breech presentation is found, the finger should always be inserted into the anus, and be made to recognize the tip of the coccyx, the tuberosities of the ischium, and the pubic arch. The position is named, as has been said, after the position of the sacrum, and it is most easily determined by finding the position of the tip of the coccyx of the fetus by rectal examination. In footling presentations one or both ankles or feet protrude through the os.

Presentation of a Hand or a Foot.—If the membranes be ruptured, a presenting hand or a foot may easily be drawn outside the vulva and be recognized by the eye; if this be impossible, it may easily be differentiated by the touch through the membranes by observation of the following points: The foot is to be distinguished from the hand by the presence of the malleoli and of the prominence of the heel, and by the facts that the great toe is of equal or greater length than the others and is placed in the same plane with them; while the hand is recognized by the absence of the heel, by the fact that it can be placed in direct continuation of the line of the limb to which it is attached, and that the thumb is shorter than the fingers and can be opposed

to them. The importance of avoiding rupture of the membranes in such presentations is, however, so great that it is usually best to trust to the results of external palpation.

Presentations of the Knee and the Elbow.—The knee may sometimes be distinguished from the elbow by the presence of the patella; but, since the latter is small and not always easy of recognition, it is best to distinguish between these two joints by following the course of the limb to its termination in a hand or a foot as the case may be.

Transverse Presentations.—The shoulder is liable to be mistaken only for the breech, from which it may be distinguished by the presence of but one limb in place of the two which are attached to the pelvis, and by recognition of the smooth ridge of the scapula as opposed to the rough spines of the sacrum; recognition of the clavicle and the ribs will also assist the diagnosis; but the recognition of a shoulder by vaginal examination is extremely difficult, and the existence of the presentation is practically ascertained, in the majority of cases, by external palpation, without assistance from vaginal examination.

In presentations of the hand it is sometimes possible to make a diagnosis of position by observation of the hand alone; to this end it is first necessary to determine which hand of the fetus presents, this being best ascertained by attempting to shake hands with the presenting part, the right hand of the fetus coming into position to shake hands with the right hand of the physician, and the left with the left. If the presenting hand be turned by rotation of the forearm into forced supination, the thumb points to the side on which lies the fetal head, and the back of the hand corresponds with the back of the fetus; but in actual practice the attitude of the child so seldom corresponds exactly to any one of the four classical positions that this evidence is of comparatively slight value, and is only to be used as confirmatory of the results of palpation.

FREQUENCY.—The vertex presents in about 97 per cent. of all labors, the breech presents in about 2 per cent., and the remaining 1 per cent. is made up of brow, face, and transverse presentations, the latter two being the more frequent.

PROGNOSIS.—Vertex Presentations.—In vertex presentations the prognosis for mother and child is better than in any other variety of labor. It is, however, to some slight degree with the position, being better in anterior than in posterior positions, on account of the somewhat longer and more difficult labors which are to be expected, as will be seen, in the latter.

Face Presentations.—In face presentations the prognosis, though not necessarily bad, is always worse for both mother and child than in vertex cases; for, although the majority of face labors are terminated with safety and rapidity by the efforts of nature, yet in the comparatively small number of cases in which an arrest occurs, and in which art must step in, the delivery is often extremely difficult. The prognosis for the mother is that of the operation indicated, but in the operative delivery of face cases the dangers to the fetus are always peculiarly great.

Brow Presentations.—In brow presentations the prognosis for both patients is that of the operation by which the case is delivered. It is therefore necessarily worse than that of vertex presentations.

Breech Presentations.—In breech presentations the prognosis for the mother is only altered from the normal by the fact that the rapid extraction of the after-coming head and arms that is very frequently necessary is attended by a greatly increased liability to perineal and cervical lacerations. The prognosis for the child is always bad, especially among primiparæ or with women who for any other reason have rigid soft parts.

Transverse Presentations.—Transverse presentations must always be terminated by art, and the prognosis varies with the period of labor at which interference is undertaken. In uncomplicated transverse presentations an early version is usually easy, and the prognosis for both patients is therefore good. In neglected cases the operation is always difficult, and the prognosis for both patients is bad.

1. VERTEX PRESENTATIONS.

Frequency of Cephalic Presentations.—At the end of pregnancy the cephalic end of the child presents in about 97 per cent. of all cases. In 97,871 births in private practice Spiegelberg found head presentations in over 97 per cent. In 23,000 cases confined in Guy's Hospital Lying-in Charity the percentage of head presentations was 96.9. Premature delivery and stillbirth of the fetus decrease greatly the proportion of head presentations. Thus, Collins found that head presentations occurred in 97 per cent. of living children among about 16,000 deliveries at term, and in only about 80 per cent. among 500 births of putrid fetuses. Churchill found that at seven months only 83 per cent. of living and 53 per cent. of dead children are born by cephalic presentation. DuBois found 83 to be the percentage for living children and 45 for dead children at the same period.

It is found that during the latter months of pregnancy changes in the presenting pole of the fetus occur once or more in from 35 to 40 per cent. of all cases. The change from a pelvic or a transverse presentation to a cephalic, however, is very much commoner than the loss of a cephalic presentation. The latter would therefore seem to be the position of more stable equilibrium, and it will be found that these observations—namely, the decreased percentage of head presentations among premature and stillborn children, and the greater stability of head presentation as compared with any other—have an important bearing upon the etiology of the presentations.

Relative Frequency of the Four Positions.—In about 75 per cent. of all cephalic presentations the occiput is found upon the left side of the mother, and in more than 73 per cent. of this 75 per cent. the position is anterior—that is, O. L. A. In the remaining 25 per cent. the occiput is of course directed to the right side of the mother, but the determination of the relative frequency of right anterior and right posterior positions is not so easily determined, there being great differences of opinion upon this point among

different observers, the key to this difference of opinion being probably found in their adoption of different periods of labor for the determination of the position.

In a large proportion of those cases in which the occiput is to the right and somewhat anterior at the very beginning of labor—that is, before the head is even pressed into the superior strait—the position becomes right posterior as soon as engagement occurs. It is probable that some observers have classified such cases as O. D. A., and others as O. D. P. Again, the enormous majority of right posterior positions become right anterior by rotation during the second stage of labor. An observer who made his diagnosis only during the latter part of the second stage would class all such cases as anterior positions. It is certainly a fact that the vast majority of right positions are right posterior positions at the time when the greatest diameter of the head occupies the superior strait; and if this period of labor be selected as the time when the position should be determined, it is safe to say that nearly 75 per cent. of all cases are primarily O. L. A., and almost 20 per cent. are primarily O. D. P. Of the small remainder, almost 4 per cent. are primarily O. D. A., and but a little over 1 per cent. are O. L. P.

Etiology of Presentations.—Three conditions have been urged as chiefly contributing to the frequency of cephalic presentations, and it seems probable that the true cause must be found in a combination of all three conditions, which probably vary in their importance in individual cases. These three causes are—first, the effect of gravity; second, the easier adaptation of the fetus to the uterine cavity in head presentations; and third, the effect of active movements on the part of the fetus.

In estimating the relative importance of these factors in the etiology of head presentations, it is evident that to attain the truth it is necessary to reach a conclusion which will explain the results of clinical observation recorded above, and which will make evident not only the reasons for the great preponderance of cephalic presentations of the fetus, but also for its variability in accordance with the period of delivery and the condition of the fetus.

The Influence of Gravity.—It has been found by experiment that if a recently-dead fetus at term be immersed in a saline fluid of the specific gravity of the liquor amnii, it tends, under the influence of gravity, to assume an oblique position, with the head lower than the breech and the right side lower than the left. This fact is explained by Matthews Duncan, who has shown that the specific gravity of the fetal head is greater than that of the decapitated trunk, and that the greater specific gravity of the right side is due to the enormous relative size of the liver in the new-born child. It is evident, then, other conditions being equal, that we may expect, in a preponderance of cases, to find the head and right shoulder of the fetus in that portion of the uterus which is horizontally lowest in the ordinary positions of the mother.

The ordinary positions of the mother may be considered in this connection to be three—the vertical position of the trunk, the horizontal position in a dorsal decubitus, and the horizontal position in a lateral decubitus. When

the trunk is erect the anterior uterine wall is inclined to the horizon at an angle of about 35° , and the lowest portion of the uterine cavity is to be found in the neighborhood of the pubes. Most pregnant women are in this position—that is, either standing or sitting—for about two-thirds of the twenty-four hours, and it is consequently the most important of the three positions in this connection. In this position of the mother the child would tend to assume, under the influence of gravity, precisely the position in which it is usually found—that is, a vertex presentation, O. L. A.—and in the absence of disturbing elements it will be in this relation to the mother about two-thirds of the time.

When the woman lies upon her back the posterior uterine wall is inclined to the horizon at an angle of about 55° , and the lowest portion of the uterus is in the neighborhood of the promontory. Thus, in this position also the influence of gravity tends to maintain a cephalic presentation.*

When the woman lies upon her side the lowest point of the uterine cavity is usually near the fundus and toward the side upon which she reclines.† In this position, then, the influence of gravity would be exerted against the maintenance of a cephalic presentation; and since the lateral decubitus is maintained by most pregnant women for the greater part of that third of their time which is spent in bed, it is evident that the influence of gravity would not, by itself, be a sufficient cause for the appearance of a cephalic presentation in so large a number as ninety-seven out of every one hundred labors; but since, from the influence of gravity alone, it is probable that the head would maintain, other influences being excluded, a cephalic presentation during the greater part of the time, it is fair to assume that this furnishes a predisposition toward the existence of a cephalic presentation in any given case. When, moreover, we investigate the relation of this factor to the variation in percentages due to premature births and stillbirths, we find its influence so entirely in accord with the results of clinical observation as to add still further proof of its importance. Thus, Dr. Duncan found that when a child dies *in utero* before labor, the specific gravity of its head is less than that of a living child, and the body, when uncontrolled, often actually floats head uppermost in a saline fluid. Again, it is highly probable that the relative difference between the specific gravity of the head and that of the body is less among premature than among full-term children, since we know that the proportionate development of the brain and the cranial bones, in comparison with that of the body, is much less during the early months of pregnancy than it becomes at term.

It may with propriety be conceded that the greater specific gravity of the cephalic pole of the fetus is a predisposing cause of head presentations, and it only remains to be determined whether the other causes are sufficient to maintain this position when once established.

* Though with the back of the fetus toward the back of the mother (see *Etiology of Position*, p. 422).

† When the woman lies upon her right side the influence of gravity tends to turn the back of the child forward, and when she lies upon her left side tends to turn it backward.

Adaptation between Fetus and Uterus.—It is usual to consider the uterus as a flaccid mass which readily moulds itself to the shape of its contents or its surroundings; but when we remember that during each contraction the uterus straightens itself and tends to assume a definite form, and that, moreover, there is undoubtedly a process of slight rhythmic contraction going on throughout the whole of the latter part of pregnancy, it is evident that the uterus must be regarded as a body which has, to some extent at least, a definite, intrinsic shape. It has, moreover, been determined by post-mortem examinations that this shape is one which alters, and alters in a definite direction, during the development of the uterus.

At and for some time before the fifth month the uterine cavity is nearly spherical (Fig. 232), and is very large as compared with the still small and undeveloped fetus; but from this time on the cavity becomes progressively



FIG. 232.—Relative size of the fetus and the uterine cavity at the fifth month.



FIG. 233.—Adaptation between the uterus and the fetus at term in vertex presentation.

more and more pyriform, until toward the end of pregnancy it assumes the definitely pyriform shape shown in Figure 233. The uterine cavity, at term and under normal conditions, is but little larger than the fetus.

It is, moreover, evident, on comparing the shape of the fetus in its ordinary attitude with the shape of the uterus at term, that in head presentations (Fig. 233) the fetus and the uterus are extremely well adapted to each other, but that in breech (Fig. 234) or in transverse presentations one portion of the uterine muscle is subjected to an undue amount of tension, while other portions are unduly relaxed; therefore any change from the cephalic to either a breech or a transverse presentation will be opposed by the contractile power of that portion of the uterine muscle that would be overstretched in the new presentations; that is, we may assume that the shape and contractility of the uterine walls tend to preserve a cephalic presentation when this is once well established, and that the rhythmical contractions would probably tend to re-establish it when lost. It is safe to assume, then, that the shape of the uterus may be considered an important factor in preserving a cephalic presentation

when this has once been established by the influence of gravity, and that its insensible contractions furnish an influence of importance in re-establishing a head presentation when this has been lost.

Influence of the Fetal Movements.—Since the fetal movements are accidental and independent of any volitional impulse, it is probable that their occurrence would be insufficient to effect any considerable change in the relation of the fetus to the uterus unless in an extremely relaxed condition of the uterine and abdominal walls, and that even in such uteri the change would be likely to occur only when the position of the mother added the influence of gravity to the effect of fetal movements. It is evident that even in such cases the operation of the same causes would probably tend to a speedy assumption of the cephalic presentation.

Conclusions.—It is now necessary to consider how far the conditions just enumerated explain the observed facts quoted at the beginning of this section: *First*, that cephalic presentations preponderate in the proportion of 97 to 3; *second*, that this preponderance is much decreased by both premature deliveries and stillbirths; *third*, that the change from a pelvic or a transverse presentation into a cephalic is very much more common than the loss of a cephalic presentation; and *fourth*, that both abnormal presentations and changes of presentation are much commoner among multiparæ and when the quantity of liquor amnii is large. †

First.—The existence of a condition, the influence of gravity, that tends to establish a cephalic presentation, and that is operative for two-thirds of the time, in combination with other conditions which render any other presentation unstable, and which are operative all the time, is, in the absence of anything which favors any other presentation, sufficient to account for almost any percentage of preponderance of cephalic presentations.

Second and Third.—In the middle of pregnancy the shape of the uterine cavity is nearly spherical and its size is greatest as compared with that of the fetus; the latter is but little developed and the presentations are totally uncertain. During the sixth and seventh months the conditions approach nearer to those observed at term; but even in the eighth and ninth months the difference in the specific gravity of the cephalic and pelvic ends of the infant is less marked than at term; the pyriform shape of the uterus is less strongly marked, and the adaptation between the uterus and the fetus is less close; that is, all the factors which we have been considering as important in the production of the preponderance of cephalic presentations have less value than at term. We find by observation that at these periods the preponderance of



FIG. 234.—Adaptation between the fetus and the uterus at term in breech presentation.

cephalic presentations is correspondingly decreased, and that spontaneous changes of presentation are correspondingly much more frequent than at the end of pregnancy; we are, then, justified in our belief in the importance of these factors.

Fourth.—These considerations are in full accord with the observed fact that both abnormal presentations and changes of presentation occur most frequently in multiparæ with relaxed uterine and abdominal walls, and are but rarely seen in the more rigid condition of the muscles that is characteristic of first pregnancies. So, too, it is fully established that these changes and abnormal presentations occur much more frequently when the quantity of liquor amnii is relatively so great that the uterus tends through distention to acquire a more nearly spherical shape, and when the limbs of the fetus are accorded much greater freedom of movement.

As a result, it seems safe to assume that the influence of the relatively greater specific gravity of the cephalic pole of the fetus is the predisposing cause, and that this, together with the intrinsic shape of the uterine cavity and the influence of the movements of the fetus, are the maintaining causes of the great preponderance of cephalic presentations.

Etiology of Position.—It has already been observed (p. 419) that in the erect posture of the trunk, usually assumed by the woman for two-thirds of the twenty-four hours, the influence of gravity tends to the production of an O. L. A. position, and in the remaining one-third of the twenty-four hours the influence of gravity varies with the decubitus which the woman assumes in bed. Therefore it may safely be assumed that any conservative factors which appear late and tend to fix the child in any position in which they find it are more likely to find it O. L. A. than in any other position. Such a factor is to be found in the shape of the superior strait. The presence of the rectum in the left ilio-sacral notch renders the second oblique diameter of the pelvis less ample than the first, so that if the oblique cross-section of the head that is ordinarily presented to the pelvis at the inlet rests with its long diameter in correspondence with the second oblique diameter at the brim, the head is less easily accommodated than if it is presented to the first oblique diameter. It will, then, as the adaptation becomes progressively tighter and tighter, tend to remain in the first oblique diameter for longer periods than in the second; that is, it will be dislodged with difficulty from the first oblique diameter, and with ease from the second by any slight cause; and since the influence of gravity tends during the greater part of the time to turn the occiput forward, a head which occupies either an O. D. A. or an O. L. P. position will tend to become O. L. A. rather than anything else. The maintenance of an O. D. P. position is, moreover, rendered comparatively unlikely from the fact that the shape of the head is less well adapted to that of the pelvis in this position. Changes of position are, in fact, extremely frequent until within the last few weeks before delivery, and the position, moreover, is never finally determined until the head engages at the brim.

Diagnosis.—On *abdominal examination* the head is found at the inlet; the

fetal limbs and the most accessible end of the head are found on one side of the abdomen, and the heart on the other. On *vaginal examination* the finger should recognize the small fontanelle on one side of the pelvis, and by following the sagittal suture should find the large fontanelle on the other. The ears should always, and the mastoids and lateral fontanelles should usually, be felt at the ends of the lambdoidal sutures.

Prognosis.—The prognosis for both mother and child is better than in any other variety of labor.*

A. Mechanism of the First Stage of Labor.

It is customary to divide labor into three stages. The first stage comprises the time occupied in the dilatation of the os; the second, that expended in the descent and expulsion of the child; while the third is occupied by the birth of the placenta.

For purposes of description it is well to consider the three stages as being sharply divided from one another, but it must be remembered that clinically the division between the first and second stages is often difficult and indefinite, since the final stages of dilatation are not infrequently accomplished only during the descent of the head; and for clinical purposes it is well to define the end of the first stage as occurring whenever the os is fully dilated or dilat-able, it being understood that the expression "fully dilat-able" refers to a condition in which the os, though still imperfectly dilated, has become so soft and elastic as not to offer any efficient obstacle to the descent of the presenting part.

To understand exactly the mechanism of labor it is necessary to discuss first the forces by which the process is accomplished, and next the manner in which each force acts during the different stages of labor.

The forces by which labor is effected are those produced by the contraction of the uterine and abdominal muscles, together with such influence as can be effected by the weight of the child and the waters.

The uterine muscle acts in two ways: first, by diminishing the intra-uterine area and thus creating a general intra-uterine fluid-pressure due to the contraction of the uterus upon the fluid contents of the unruptured ovum; second, by the force of direct contact between the breech and the fundus of the uterus whenever a rupture of the membranes and the consequent escape of the waters permit this contact to occur. Direct contact may also occasionally occur, as will be seen later, before the rupture of the membranes.

The abdominal muscles when set into voluntary contraction reinforce both forms of action of the uterine muscle. When the uterine muscle is in direct contact with the breech, the abdominal muscles, lying in close contact with the uterus, add their force to that which the uterus itself exerts against the child; when the child is protected from contact with the uterine walls by the presence of a quantity of liquor amnii, the contraction of the abdominal muscles again adds itself to that of the uterine wall, and thus adds its increment to the general intra-uterine fluid-pressure. The force of gravity is inactive in many positions of the mother, and is at most an increment of but small importance.

In considering the manner in which the above-mentioned forces are employed in effecting the dilatation of the os during the first stage of labor, it is necessary to consider several variations which may occur in the mechanical conditions. When the waters are abundant and the membranes persist unbroken throughout the first stage, the dilatation is usually accomplished by the action of the membranes only. This may be considered the normal mechanism of dilatation, and must be described first, after which it will be proper to take up the various conditions in which, from one cause or another, the membranes cease to act their proper part, and the dilatation must be accomplished by the pressure of the fetal head against the cervix.

Normal Mechanism of Dilatation.—In the first instance—that is, when the waters are abundant and the membranes are intact—the position of the

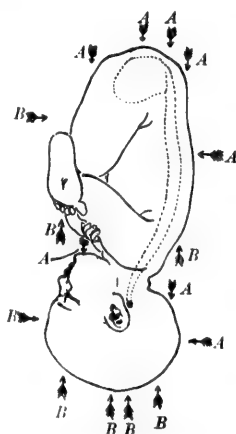


FIG. 235.—Diagram illustrating the absence of alteration in the attitude of a child by the action of opposite and equal fluid-pressures.

fetus is unaffected by the intra-uterine fluid-pressure. It is an axiom in physics that fluid-pressures, however produced, are invariably equal and opposite in all directions, from which it follows that, the pressures *A* (Fig. 235) being equal and opposite to the pressures *B*, the child will be unmoved by the uterine contraction. Similarly, the fluid-pressure upon any one portion of the uterine wall being equal to that exerted upon any other portion of equal area, there would be no effect, even upon the shape of the uterus, if its entire surface contracted at once and if its walls were of uniform strength throughout. The initial stages of dilatation of the os are in reality to be referred to the fact that the lower

uterine segment possesses less muscular strength than the upper part of the uterus, and to the character of the uterine contractions. Neglecting for the moment the latter factor, and limiting the discussion to the effect of the different strengths of the upper and lower uterine segments, we shall see that the contraction of the more powerful upper part of the uterus forces the less powerful lower portion open, notwithstanding its efforts at contraction.

The total force exerted by the uterine contractions results in the application of a uniform centrifugal pressure upon all portions of the containing wall. The amount of this pressure upon any given unit of surface—as, for example, a square inch—will, of necessity, be equal to the average force exerted by the same superficial extent of the uterine wall; hence it follows that at any portion of the viscus where the strength of the wall is greater than the average the contracting centripetal force will tend to overcome the resulting centrifugal

force, and the result will be a decrease in the extent of the uterine walls at that point. Similarly, at any point where the strength of the uterine wall is below the average the expanding centrifugal force of the fluid-pressure will be greater than the centripetal force of the contracting muscles, and at such points, therefore, the expanding force of the fluid-pressure will tend to overcome the contracting force of the uterine muscles, and there will be a consequent increase in the area of those portions of the uterine wall. Now, the lower uterine segment is by all odds weaker than any other portion of the uterus; it therefore tends to expand during the contraction from the action of the general intra-uterine fluid-pressure.

The circular portion of the uterine area, which is opposite to the lumen of the vagina, is, moreover, unsupported by the general intra-abdominal pressure and by the force of the tonicity of the abdominal muscles that is exerted upon all the other portions of the uterus—a fact which, by decreasing the centripetal force, still further increases the surplus of the centrifugal element at this point. As a matter of fact, at the beginning of labor the first influence of the uterine contractions is seen in the assumption by the lower uterine segment of a more expanded shape, such as shown by the dotted outline in Figure 236. Moreover, since at one point in the lower uterine segment the cohesion of its substance is still further lessened by the existence of a solution of continuity, the lumen of the os uteri, it is evident that there will be a still more marked tendency to expansion at this weakest spot, resulting in a tendency to dilatation of the os.

To these considerations must be added the effect of the peculiar composition of the uterine muscle and of the peculiar character of its contractions. It is essential to remember that this highly composite muscle is made up of interlacing fibres, whose action may mechanically be divided into one set of longitudinal and one of circular stresses; that is, if the action of those fibres having an oblique direction be resolved, as is physically allowable and proper, into their longitudinal and transverse resultants, the action of the whole will be found precisely equal to that which would be exerted by two hypothetical sets of fibres, of which the first and most powerful set directly encircle the uterus in horizontal zones, while the second and less powerful set extend upward through the margin of the os, cross the fundus, and thence passing down to reach the margins of the os at points opposite to their origins.

If a uterine muscle so composed were set into action, it will be seen that,

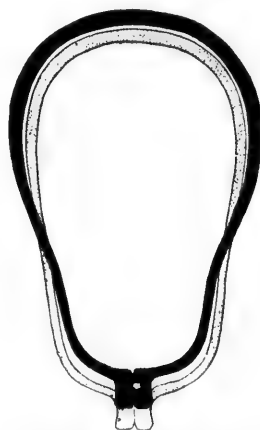


FIG. 236.—Diagrams showing the diminution of the upper uterine segment and the expansion of the lower segment during each contraction.

from a mechanical standpoint, the circular fibres surrounding the os would by their contraction tend to keep it closed, while the longitudinal fibres, acting in opposition to these, would by their contraction tend to open the os by drawing its margins apart over the contained ovum. This conception, though somewhat more simple than the actual anatomical fact, is mechanically essentially correct; but, since the circular stresses are the more powerful, it is evident that this arrangement cannot result in the dilatation of the os unless complicated by the presence of some additional factor. This factor is found in the circumstance that the contractions of the uterine muscles, like those of all the hollow viscera of the body, are peristaltic, and that the rhythmic contraction of the uterus begins at the fundus and passes gradually down to the cervix. Each contraction of a given part of the uterus is preceded and followed by a relaxation; but since, from the interlaced arrangement of the fibres of the uterus, the contraction of any portion of its surface necessarily exerts a longitudinal strain, it will be found that the outward stress upon the margins of the os remains nearly constant, while its circular contraction is intermittent; it is probable that the initial dilatation of the os is largely due to the constancy of the longitudinal and the intermittency of the circular strain; that is, the first gains in dilatation are made at moments when the uterine muscles of the lower uterine segment and the cervix are relaxed, but when the general fluid-pressure is maintained by contractions of the upper portions of the uterus.

As the internal os and the upper portion of the cervix dilate under the action of these forces, a new mechanism comes into play through the elasticity of the membranes, which bulge through the circle of the os and enable the intra-uterine fluid-pressure to take direct effect upon its margins. As this process continues the internal os becomes effaced, the cervix is shortened and

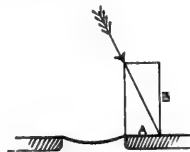


FIG. 237.—Diagram illustrating the dilatation of the os by the membranes. If the application of the fluid-pressure to the os (at right angles to the surface of the membranes at this point) is represented by the direction of the arrow, and the amount of the force by the length of the diagonal line which continues the arrow, the amount of force that is applicable to the dilatation of the os is represented by the length of the line A.



FIG. 238.—Diagram illustrating the dilatation of the os by the membranes. All the conditions are identical with those of Figure 237, except that the membranes have a greater convexity; the direction of the arrow is therefore more oblique, and the force efficient for dilatation, represented by the line A, is greatly increased.

disappears, and finally the external os itself is in direct contact with the membranes and begins to receive directly the effect of the longitudinal stresses. As the external os dilates the membranes again bulge forward into its lumen, and the force of the fluid-pressure becomes directly active upon its margins. The force so exerted is directly proportional to the convexity of the membranes, and increases as the convexity increases—a fact which is explainable by well-

known physical laws as follows: The force of fluid-pressure, in addition to being opposite and equal at all points, is always exerted at right angles to any surface against which it is applied. If it is necessary to ascertain what portion of the force is exerted in any given direction, it is only necessary to break up the internal force into its elements by the construction of a parallelogram of forces, such as is described in all elementary treatises on mechanics and illustrated in Figures 237 and 238. Figure 237 exhibits the influence of the general intra-uterine fluid-pressure when the conditions of the case allow but a slight convexity to the unsupported portions of the membranes. The expansive element of the fluid-pressure is here represented by the line A, while in Figure 238, where the convexity of the unsupported membranes is much greater, the expansive element of the force will be represented by the length of the much longer line A: from this it follows that, other things being equal, the rapidity of dilatation will be proportional to the degree to which the membranes project through the os. As will be seen later, the same considerations are equally applicable to the action of the head in producing dilatation after the rupture of the membranes. The familiar clinical fact that the closing stages of dilatation are usually much more rapid than the beginning stages is fully explained by the foregoing considerations, taken in connection with the equally familiar fact that the contractions of the uterus tend normally to become stronger and stronger throughout the process of labor.

In the more normal form of the mechanism of the first stage—that is, so long as the membranes remain intact—the progress of the first stage of labor is dependent mainly upon the first form of force which the uterine muscle is capable of exerting—that is, the force of the general intra-uterine fluid-pressure—and the membranes are the dilating agent.

The second form of force, that of the direct pressure of the uterine muscle against the child, is under these circumstances inoperative, while the fact, that the voluntary muscles of the abdominal walls are but seldom brought into play by the patient, reduces the action of the remaining or auxiliary forces, in this form of the mechanism of the first stage, to the small reinforcement of the general intra-uterine fluid-pressure, which is due to the general intra-abdominal pressure constantly exerted by the tonicity of these muscles.

Mechanism of Dilatation of the Os after Rupture of the Membranes, with Partial or Complete Escape of the Waters.—*Partial Escape.*—After the rupture of the membranes the liquor amnii tends to drain away until its escape is stopped by the contact of the presenting part with the margins of the os (Fig. 239). In this condition the presenting part forms with the circle of the os a ball-valve; the general intra-uterine pressure is concentrated upon its upper surface, and its descent is opposed only by the comparatively feeble resistance of the cervix. When this condition occurs the portions of the fetus that correspond with arrows marked A' and B' are still affected by pressures which are opposite and exactly equal to the propelling force exerted upon the portions which correspond with the arrows A and B, but the propelling force represented by the arrow C is opposed only by the resistance of the

unsupported cervical and vaginal tissues, against which the head is pressed by a force equal to the effect of the intra-uterine fluid-pressure upon an area

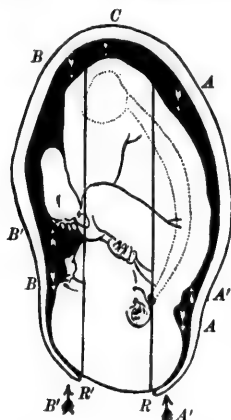


FIG. 239.—Diagram illustrating the manner in which the general intra-uterine fluid-pressure becomes propulsive after the rupture of the membranes.

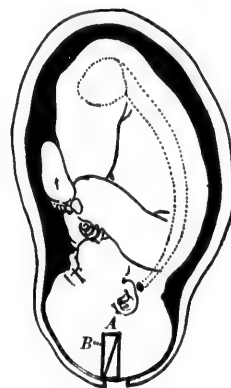


FIG. 240.—Diagram illustrating the dilatation of the os by the head. The total force is again represented by the oblique line, and the force which is applicable for dilatation is represented by the line A.

equal to the transverse area of that zone of the uterus where the head first comes in contact with the walls—that is, the surface *B* to *R'*.

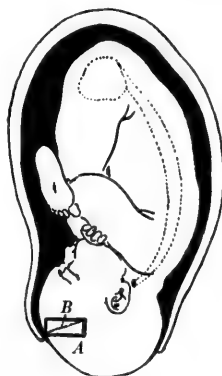


FIG. 241.—Diagram illustrating the dilatation of the os by the head. The total force is represented by the oblique line, and the force applicable for dilatation is represented by the line A.

From the comparative rigidity of the spherical head it can exert but little direct expansive force upon the margins of the os during the early stages of dilatation (Fig. 240)—a fact which explains admirably the relatively slow progress of dilatation after early rupture of the membranes. When, however, the os has so far dilated as nearly to admit the greatest circumference of the head, its action is that of a slightly tapering wedge, by which almost the whole power of the propelling force is transmitted into an outward pressure of the margins of the os, and which must compel an extremely rapid completion of the dilatation* (Fig. 241).

It will be seen that in this second form of the mechanism of the first stage the force employed is still that of the general intra-uterine fluid-pressure, but that the dilating agent is now the head.

* It will be seen that this fact is an adequate explanation of the greater frequency of laceration of the cervix when a rupture of the membranes results in the completion of the dilatation by the direct pressure of the rigid head.

After Complete Escape of the Waters.*—The escape of any considerable quantity of the waters usually results in contraction of the uterus sufficient to permit of firm contact between the fundus and the breech of the child. The force of this contact is then transmitted to the head through the vertebral column of the fetus. At first sight it seems unlikely that any considerable force could be transmitted through so flexible a rod as the vertebral column of an unborn child. This transmission is, however, rendered possible by the following conditions: It is an observed fact that during a contraction the long diameter of the uterus, far from being decreased, is actually lengthened. This phenomenon is due to the superior strain of the circular stresses, which by their greater force decrease the antero-posterior diameter of the uterus and thereby† increase its length (Figs. 242, 243); the lateral uterine walls, at the



FIG. 242.—Diagram illustrating the alteration in the shape of a cross-section of a uterus during its contractions. The heavy line represents the non-contracted, the dotted line the contracted, uterus (compare Fig. 243).

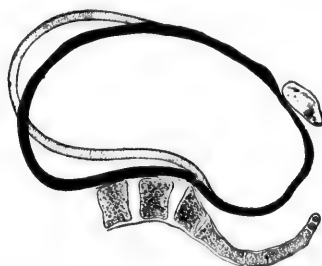


FIG. 243.—Diagram illustrating the alteration in the shape of a sagittal section of the uterus during its contractions. The heavy line represents the non-contracted, the dotted line the contracted, uterus.

same time, come into strong contact with the surface of the fetal body, and so straighten out the child, thus increasing the violence of the contact between the breech and the fundus, and affording a firm supporting surface which prevents any bending of the vertebræ, and converts the backbone for the moment into a mechanically rigid rod which is fully capable of the transmission of force. When this form of mechanism obtains, the head acts as the dilating wedge, and the second form of force, that furnished by direct contact between the breech and the fundus, is alone active.

Mechanism of Dilatation of the Os with Originally Scanty Waters.—

It occasionally happens that the waters are originally so scanty in amount as to permit direct contact between the breech and the fundus to occur early in the first stage. Under these circumstances the head is brought into close contact with the os at the beginning of labor. The mechanical conditions are now closely similar to those which obtain after the escape of the waters, with the single exception that if the membranes are tough and inelastic their tension may somewhat impede the progress of the head.

* This term, though conventional, is inaccurate, as there is almost always some liquor left in the uterus.

† The ovum being incompressible.

Mechanism of Dilatation with Undue Elasticity of the Membranes.—

FIG. 244.—Diagram illustrating the formation of a ball-valve by contact between the head and the edges of the os. The waters behind the head are exposed to the general intra-uterine fluid-pressure, while the fluid-pressure in advance of the head is only created by the elasticity of the fetal membranes.

If the membranes are unusually elastic, it may sometimes happen that after the formation of a considerable pouch of membranes in advance of the head, the volume of the uterine contents may be lessened sufficiently to permit the head itself to be brought into close contact with the margins of the os, by the force of a perhaps temporary direct contact between the breech and the fundus. In this position, if the head is in contact with the entire margin of the os, it forms with it a ball-valve by which the "fore-waters" are entirely cut off from the uterine contents. The pressure, *C* (Fig. 244), is now opposed only by the elasticity of the membranes and of the vaginal tissues. The general fluid-pressure is no longer exerted against the margins of the os, and the conditions are mechanically similar to those illustrated in Figure 239.

**B. Mechanism of the Second Stage of Labor in Vertex Presentations,
O. L. A.**

The second stage of labor is commonly divided into three sub-stages: The descent and expulsion of the head; external restitution; and the delivery of the trunk.

The adaptation between the normal head and the pelvis is so close that for the accomplishment of the descent and expulsion of the head there is required the occurrence of a set of somewhat complicated movements which are, in fact, essentially one single complex motion. This motion consists of three elements: (1) The descent of the head through the pelvis; (2) a change from the partially extended position which the head normally occupies at the beginning of labor to one of complete flexion; and (3) lateral rotation of the head within the canal, from the oblique position which the suboccipito-bregmatic diameter occupies at the brim to the antero-posterior position in which it emerges from the outlet. Although it is necessary in discussing this motion to describe its components separately, it must not be forgotten that no one of its parts can proceed to its accomplishment without the coexistence of the others. Thus, descent can be accomplished only during the existence of flexion, while flexion is produced only by the act of descent. So, too, the final stage of descent, known as *expulsion*, is normally impossible without rotation, while rotation occurs only during the descent of a fully-flexed head. The most intelligible

way of describing these highly complex phenomena is by a chronological study of the mechanical conditions which occur and succeed each other during the stage of descent and expulsion.

Descent.—It is necessary, in describing the mechanism of the second stage, to begin by considering the action of the forces by which the mechanism of this stage is effected. So long as the fetus is exposed on all sides to contact with the liquor amnii, the contractions of the uterine and abdominal muscles can produce no effect upon it other than that of subjecting it to a uniform fluid-pressure, equal and opposite in all directions. In point of fact, the mechanism of descent does not begin until the presenting part is cut off from the liquor amnii by coming into apposition with the edges of the os. As was implied in the last section, this contact may happen in either of two ways:

First: When the mechanism of the first stage is such that the head comes into close contact with the margins of the os before any considerable quantity of the liquor amnii has escaped from the uterus, it forms with the os a ball-valve (p. 430), by which the remaining part of the waters is retained within the uterus; and the occurrence of descent is then the result of the action of the intra-uterine fluid-pressure. This is the *normal*—that is, the most usual and the most favorable—*mechanism of descent*.

Second: When close contact between the head and the os does not occur until after the complete escape of the waters, the uterine muscle contracts upon the child, and the force of the circular stresses (p. 425) is lost so far as the production of descent is concerned, but the breech and the fundus of the uterus come into contact with each other, and the force of the longitudinal stresses is thus still available. This second form of the mechanism of the second stage is commonly called a "dry labor," and such labors are, with reason, much dreaded by obstetricians, because the loss of the powerful circular stresses usually leads to a protracted second stage.

Normal Mechanism of Descent.—The portion of the head that is without the uterus (*B, R'*, Fig. 239) is opposed only by the resistance of the vaginal tissues. Every other portion of the fetus is exposed to the general intra-uterine fluid-pressure. If it is remembered that fluid-pressures are always equal and opposite, it will be seen that the forces *A* and *B* are directly neutralized by the forces *A'* and *B'*, and that the force *C* is opposed only by the comparatively trifling resistance of the vaginal tissues. This force (*C*) is then practically unopposed, and is therefore efficient for descent.

Mechanism of Descent in Dry Labors.—When the escape of the waters has permitted the uterus to contract upon the child, the advance of the presenting part is opposed only by the vaginal tissues, and is favored by the force of all the longitudinal stresses of the uterine muscle; * but unless the descent progresses rapidly a localized contraction (p. 429), due to the unopposed action of the circular stresses, leads to a lessening of the calibre of the uterine canal at any point where the diameter of the child is small—for example, the neck (Fig. 245)—and the descent of the child is then further opposed by the fact

* And by the auxiliary efforts of the abdominal muscles.

that the shoulders must be made to dilate this ring—that is, to overcome the tonic contraction of the circular stresses. In dry labors, then, the force of the circular stresses is not only lost as a factor in the production of descent, but may sometimes also be opposed to it.

Flexion.—At first sight it would seem that the only result to be expected in either case would be the occurrence of descent, and that as the head is normally somewhat extended at the beginning of labor, this descent would oppose to the pelvic diameters the always difficult and frequently impossible occipito-frontal diameter. A somewhat more careful examination will demonstrate, however, that the propelling and opposing forces are already so disposed upon the head as to favor, from the start, the occurrence of flexion, and that the first movement of descent will, under normal circumstances, tend to bring to the brim the much smaller suboccipito-bregmatic diameter. To this end two factors contribute: first and most important, the articulation of the



FIG. 245.—Constriction-ring about the neck of the child (one-sixth natural size).



FIG. 246.—Diagram of head lever.

vertebral column to the skull at a point much nearer to the occipital than to the frontal end of the head; second, the mechanical effects of the irregular shape of the skull.

Unequal Lengths of the Ends of the Head.—The effects of the excentric position of the occipito-atlantoid articulation must be investigated separately for each of the three forms of force that may be active—that is, for the force of gravity, the general fluid-pressure, and the force of direct contact with the uterine muscle.

Force of Gravity.—Whenever the force of gravity is active, it is evident that the weight of the body will be transmitted to the skull through the occipito-atlantoid articulation. If the fetal head is supposed, at the beginning of this motion, to occupy a position midway between extension and flexion, the occipital and sincipital ends of the head, marked *O* and *F* respectively (Fig. 246), will rest against the uterine walls, while the force *A* is applied at the occipito-atlantoid articulation. Since the force is applied nearer to the

occipital end of the head, it is evident that a greater amount of impulse will be communicated to the occiput; and since the resistances are of necessity equal, the occiput will tend to advance more rapidly; but advance of the occiput with relative delay of the sinciput is, in effect, flexion. The head, in fact, becomes a lever of the third class, in which the pressure of the resistances applied to the longer end is more effective in delaying progress than the equal pressure applied to the shorter end of the lever.

It is further to be noticed that as flexion progresses the relation between the lengths of these arms is so altered as to make them progressively more unequal, so that, as the head flexes, the point at which the pressure of the resistance is applied to the occipital end of the head becomes progressively nearer to the vertebral articulation.

General Intra-uterine Fluid-pressure.—If Figure 247 represents the situation of the child at the end of the first stage, we see that the forces *A* and *B* are applied directly and with equal force to the ends of the head; but it is evident that the pressure (*C*) exerted upon the breech of the infant will be transmitted to the head more readily by the vertebral column than by the soft tissues of the trunk, and that a large portion of this force (*C*) must therefore be concentrated on the condyles. So far as this force (*C*) is concerned, the argument used in explaining the production of flexion by the influence of gravity applies, then, with equal force to this condition.

Direct Contact between the Breech and the Fundus.—The whole effect of a direct pressure upon the breech by the fundus will be applied to the condyles of the occiput, and, the resistances upon the occiput and sinciput being of necessity equal, while the opposing forces are concentrated at a point much nearer the occiput, it is evident that the occipital end of the head will tend to advance more rapidly than the frontal end; but advance of the occiput with relative or absolute delay of the sinciput of course results in flexion.

Irregular Shape of the Fetal Skull.—The occurrence of flexion is likewise aided by the second factor referred to above, the irregular shape of the skull. As will be seen by analysis of the opposing forces exerted at *R* and *R'* (Fig. 248), if the effect of the equal resistances at *R* and *R'* be represented by the length of the equal lines *S* and *S'* drawn perpendicular to the surface of the skull at these points (the direction in which these resistances must, according

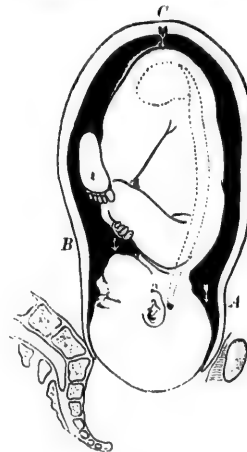


FIG. 247.—Diagram illustrating the application of a preponderance of the intra-uterine fluid-pressure to the occipital end of the head. It is evident from the condition of the head lever (see Fig. 246) that the sinciput is exposed to the force *B*, plus a small proportion of the force *C*, while the occiput receives the force *A*, plus the greater part of the force *C*.

to well-known mechanical laws, be exerted), the construction of the parallelogram of forces shows that the line T (whose length represents the portion of the resistance R which is exerted in direct opposition to descent) is much greater than that of the line T' (which represents the efficient proportion of the resistance R'). From this it is evident that the occipital end of the head is exposed not only to greater force from above, but also to less resistance from below, while the sincipital end is opposed by greater resistance and receives a less amount of propulsive power—conditions which can only result in a more rapid advance of the occiput.

As soon as partial flexion has been accomplished a second effect of the irregular shape of the head comes into play, and there must be accorded such importance as is due to it. Figure 249 represents a partially-flexed head

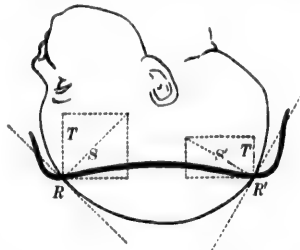


FIG. 248.—Diagram illustrating the influence of the irregular shape of the skull in producing flexion, by the construction of the parallelogram of forces. It is seen that the force which dilates the sinciput, represented by the line T' , is greater than the force which dilates the occiput, represented by the line T , which represents the sinciput.

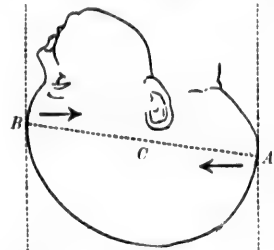


FIG. 249.—Diagram illustrating the secondary effect of the irregular shape of the head in promoting flexion after partial flexion has once been produced.

engaged in the elastic canal formed by the lower uterine segment and the vagina.* The forces A and B , due to the constriction of the elastic canal in which the head lies, and acting necessarily at right angles to the surface of contact, will then form a pair of equal but not opposite forces—in mechanical language “a couple”—the effect of which is to rotate the head upon a transverse axis at C , thus increasing its flexion.

It will be noticed that all these causes of flexion† are dependent for their existence on the presence of resistances acting in opposition to the *vis-a-tergo* which urges the head downward, and it necessarily follows from this fact that flexion occurs most rapidly and becomes most marked when the resistances are best developed—a theoretical consideration which is in thorough accord with the observed fact that there is often a temporary loss of flexion in the excavation, where the space is the greatest; that is, that flexion is generally better marked while the head is experiencing the well-developed resistances of

* The fact that the vaginal walls possess at the end of pregnancy intrinsic muscles of considerable development, though too often wholly neglected in the consideration of the mechanism of labor, is, notwithstanding, an element in the production of flexion that must not be forgotten.

† Except the last and least important.

the superior strait than in the excavation, where the resistances are less. So, too, flexion again increases when the head reaches the inferior strait. Flexion is, in fact, normally more marked in this part of the pelvis than in any other; but here another factor comes into play.

We have previously seen flexion produced by the action of the propelling forces against resistances which were exerted with approximately equal force on both the occiput and the sinciput; but when the head reaches the inferior strait its occipital end rapidly frees itself from the pressure of the bones, and is opposed only by the resistances of the soft parts of the pelvic floor, while the sinciput is still exposed to the firm resistance of the bony sacrum. It is evident that when the greater pressure is exerted on the longer arm of the lever extreme flexion is a necessary result. The mechanical explanation is thus in complete agreement with the clinical fact that the deeper is the engagement of the head, the more marked is the tendency to flexion and the greater is the certainty of its accomplishment.

Rotation.—The movements of descent and flexion make up the whole mechanism of the earlier part of the second stage of labor; but another factor—rotation—is necessary to its completion.

The mechanism of rotation is, unfortunately, extremely difficult of comprehension; and, as nothing is more difficult than to teach mechanical problems involving the use of three dimensions without the aid of models, the student will be wise if he supplements the words and figures of any written description by a constant inspection of the dried pelvis and by the results of the intrapelvic touch in actual clinical work. A complete comprehension of the mechanism of rotation is seldom acquired in any other way. The student must, at all events, grasp the fundamental fact that it does occur, and *must always occur*, before expulsion can take place.

The head enters obliquely because the oblique diameters are the largest at the superior strait, but it must emerge in an antero-posterior position—that is, with the sagittal suture opposed to the antero-posterior diameter of the outlet—because the antero-posterior diameter is the largest at the outlet. The movement by which the oblique position at the brim is converted into an antero-posterior position at the outlet is known obstetrically as *rotation*.

To understand the mechanism of rotation it is necessary to remember, first, that with good flexion (without which rotation does not occur) the occipital end of the head is on a lower level than the sincipital; that is, the occiput receives the pressure of the *lower* portion of the anterior part of one lateral wall, while the sinciput receives the pressure of the *upper* portion of the posterior part of the other lateral wall. Secondly, it is necessary to remember accurately the shape, depth, and direction of the spiral grooves described on page 396 (Fig. 218). Thirdly, it must not be forgotten that whenever one end of the head executes a movement of rotation, its other end must, of course, move simultaneously in the opposite direction. As the head enters, O. L. A., in the usual position of moderate flexion at the brim, the occiput is necessarily in contact with the upper part of the anterior groove upon the left side of the

pelvis; though the groove is here shallow, the occiput is unable to move away from it, because the bregmatic region lies at this time in the deep sacro-

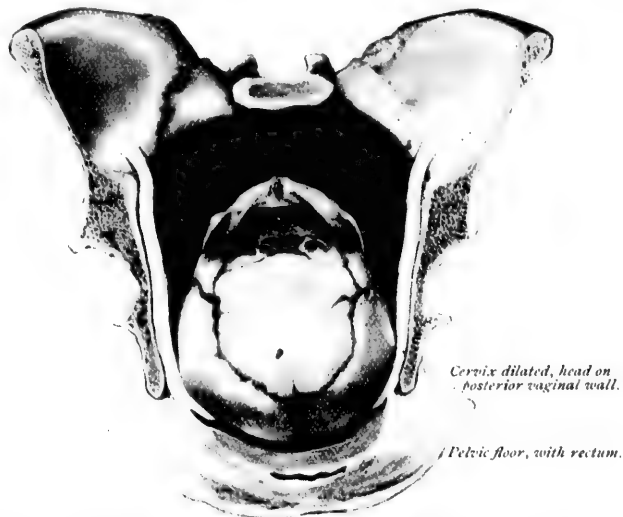


FIG. 250.—Position of the head in the inferior strait after complete rotation. The tuberosities of the ischia prevent any further rotary movement, while further descent is opposed only by the soft parts (one-third natural size).

iliac notch on the right side. As descent goes on the occiput enters the anterior groove more fully—that is, it reaches the point at which the groove



FIG. 251.—Forward motion of the head during the stage of expulsion under the influence of the forward thrust of the sacrum and the pelvic floor (one-sixth natural size).

is too deep to permit an easy escape of the occiput from its guidance—and by the time the occiput approaches the point where the groove turns forward, and

where it must itself turn forward to avoid the pressure of the projecting iliac spine, the suboccipito-frontal diameter is in the brim and the sinciput is in the sacro-iliac notch. With the next movement of descent the sinciput slips below the promontory and is in contact with the upper and shallow part of the posterior groove on the right side. The occipito-frontal diameter now occupies the extremely large oblique diameter of the excavation, and the posterior edge of the groove in which the sinciput lies is here so ill marked that, with the great space afforded by the oblique diameter of the excavation, it would be an extremely easy matter for the sinciput to slip backward into the hollow of the sacrum if any force tending in this direction were applied. This force is, in fact, applied as a result of the tendency of the occiput to turn forward along the course of the anterior groove of the left side,* under the impulse furnished by the pressure of the projecting iliac spine against the posterior surface of the occipital end of the head. But when the sinciput has once slipped backward in this way into the hollow of the sacrum, there is nothing left to prevent the occiput from turning still farther forward, until, as it reaches the median line, it receives the thrust of the other side of the pelvis, and is steadied in its

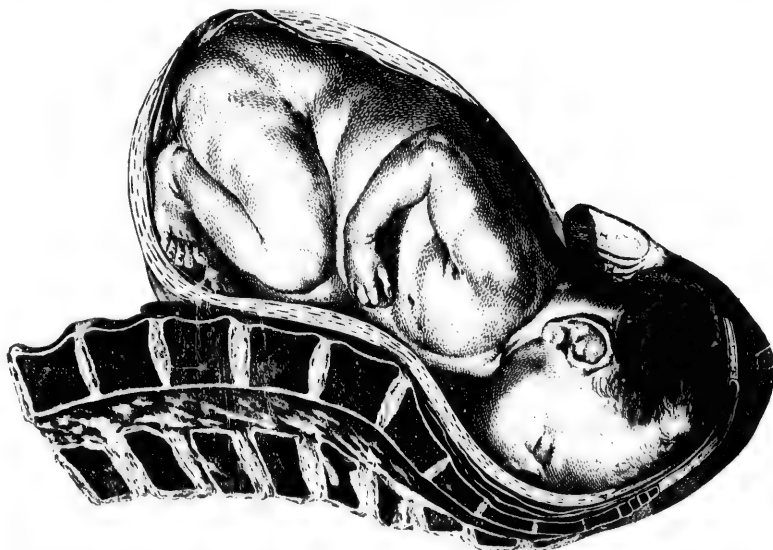


FIG. 252.—Head during distention of the pelvic floor after rotation, with beginning extension (Smellie).

median position by its reception of equal pressures on each side from the descending rami of the pubes and the tuberosities of the ischium.

Expulsion.—The parietal bosses now lie in contact with the tuberosities of the ischium. The narrow temporal diameter corresponds with the narrow transverse diameter of the pelvis between the iliac spines. The sinciput is still in

* It will be remembered that when the occiput turns forward the sinciput must of necessity turn backward.

contact with the lower portion of the sacrum, and the occiput, though steadied on both sides by the bones, finds its descent opposed only by the yielding tissues of the vaginal outlet (Fig. 250). Under these circumstances (p. 432) the propelling force from above concentrates itself upon the occiput until the perineum is fully distended. The occipital end of the head is then freed from the resistances, while the whole bregmatic region and the sinciput form a rigid slanting surface which is opposed to the slanting surface furnished by the sacrum and the perineal tissues (Fig. 251). As a consequence the driving force of the uterine pressure is converted by the shunt of these shelving surfaces into a forward thrust, under the influence of which the head, as a whole, moves forward until its progress is arrested by contact of the nape of the neck with the anterior pelvic wall. The large fontanelle is now at the fourchette, the whole of the occipital half of the head is free from pressure, while the forehead is still exposed to the driving force of the uterine muscle above and to the forward shunt of the posterior pelvic wall. The necessary result is a forward motion of the head with arrest of the neck; that is, the head extends, the bregma, the forehead, and the face successively pass the fourchette, and the head is expelled by extension (Fig. 252). It is then a convenient mnemonic that in normal labor the head descends in flexion and is expelled by extension.

The time occupied by the latter stages of the expulsion of the head—that is, the time between the first appearance of the hairless forehead and the completion of the expulsion—is usually very brief. This rapid motion of descent is usually followed by a period of inaction, which is due to the fact that the decrease in the volume of the uterine contents has been so great as to exhaust the contractile power of the uterine fibres, and to render progress impossible until after the occurrence of the peculiar phenomenon known as *retraction*.

Retraction of the Uterus.—It is well known that the amount of shortening possible to any given muscular fibre is very definitely limited, and it is believed

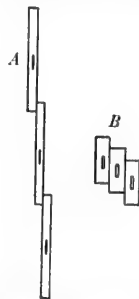


FIG. 253.—Diagrams representing the hypothetical relations between the uterine fibres in unretracted and retracted uteri: A, arrangement of the uterine fibres in the unretracted uterus; B, arrangement of the uterine fibres in the retracted uterus.

that the extreme shortening of the uterine muscle as a whole that is observed during labor is rendered possible by a process of rearrangement of the relations of the fibres of the uterine muscle to one another, known as *retraction*. The way in which this process is effected is not definitely and scientifically known, but the conception generally accepted as a working hypothesis is that the cells of the uterine muscle not only shorten, but rearrange themselves upon one another in some such way as that diagrammatically represented by Figure 253, A and B. When retraction has once taken place it is usually permanent, and the distinction between contraction and retraction, whatever it may mean pathologically, is therefore clinically

one which it is important to understand and to bear in mind. In the description of the mechanism of labor it is necessary to refer to retraction as an established entity, notwithstanding the unestablished position of the hypothesis upon which rests its existence.

When, after the expulsion of the head, retraction of the uterine fibres has been effected, the rhythmic contractions again set in and the process of expulsion of the body begins.

Expulsion of the Body: Rotation of the Shoulders.—The shoulders having entered the pelvis during the expulsion of the head, they are usually born with the next few succeeding pains. The head having entered in the *first* oblique diameter, it is evident that the shoulders, which normally lie at right angles to the antero-posterior diameters of the head, will normally enter the pelvis in the *second* oblique diameter. As the shoulders are driven down by the pains, the anterior shoulder follows the curved line of least resistance, previously travelled by the occiput, while the posterior shoulder follows the path of the sinciput. The anterior shoulder thus rotates to the arch, and the transverse axis of the shoulders occupies the antero-posterior diameter of the outlet.

Restitution of the Head.—The head, being now free from pressure, tends to retain or reassume its natural relation to the shoulders, and thus as they assume an antero-posterior diameter the already expelled head undergoes an external rotation by which the occiput is carried to a position opposite the left, and the sinciput to one opposite the right, buttock of the mother. This process is known as the *external rotation* or restitution of the head. The shoulders are, however, so small and soft as compared with the head that the mechanism of their rotation is not infrequently faulty or irregular. It may, moreover, happen that at the time of their entrance the action of the intrinsic muscles of the child may have so turned the body that the transverse axis of the shoulders lies at an acute angle to the antero-posterior axis of the head. The small and soft shoulders may from this cause enter the pelvis in the transverse, or even in approximately the first oblique, diameter. The shoulder which should normally have been the posterior may thus become the anterior, and in this way lead to such an excessive external rotation of the head that the occiput swings around to the right buttock of the mother. This faulty process is commonly known as *super-rotation*.

Expulsion of the Shoulders.—The shoulders being retained in the antero-posterior diameter by the pressure of the tuberosities, the posterior shoulder receives the forward shunt of the pelvic floor, which, together with the curvature of the body necessary to admit of the passage of the curved pelvis, jams the anterior shoulder against the symphysis pubis in such a way (Fig. 254) that the posterior shoulder sweeps forward over the perineum and is the first to reach the vulva. As the body is urged onward the perineum retracts, the anterior shoulder appears from beneath the arch, the shoulders emerge from the vulva, following the direction of the curve of Carus (Fig. 219), and the remainder of the body rapidly follows in the same path. During the process of expulsion the arms normally remain crossed upon the chest in the

usual attitude of the fetus, but they are not infrequently held back by the friction of the pelvic wall, and are thus forced into a position of partial extension in which the forearms lie across the abdomen.

The mechanism of the second stage in O. D. A. positions differs from that



FIG. 254.—Expulsion of the shoulders.

of O. L. A. only in the substitution of the word right for the word left throughout the description.

C. Mechanism and Management of the Third Stage of Labor.

Mechanism of the Third Stage of Labor.—After the expulsion of the child the uterus shuts down upon the placenta, and there is usually a period of from five to ten minutes during which little or no contraction is apparent, this interval being occupied by the process of retraction of the uterine fibres. The first active contractions of the uterus after the expulsion of the child necessarily lessen the area of the uterine surface over which the placenta is attached, and thus in part or in whole separate the placenta from the uterine wall; during the next relaxation blood escapes from the torn sinuses in the placental site, and the mechanism by which the placenta is expelled depends upon the escape or non-escape of this blood from the uterus.

If the first retraction is sufficient completely to detach the placenta, but does not succeed in expelling it, any blood which may be effused will usually find its way to the external world by dissection of the membranes from the uterine wall; during the next few contractions the uterus will be able to shut down upon the placenta, and will compel it, by the force of direct contact, to pass through the os edgewise and in the most compact possible form—that is, in the shape shown in Figure 255, in which the thin cake-like placenta is seen to have been folded upon itself in a roughly fusiform shape.

When, however, the attachment of the placenta is too firm to permit an immediate separation, or when, as probably more frequently happens, the contraction of the fundus is more energetic than that of the lower portion of the uterus, so that only the upper portion of the placenta is detached, the relaxation following each contraction will be accompanied by an effusion of blood which is confined behind the placenta. The upper part of the placenta will then be

forced downward, and as the detachment proceeds the position of the placenta will be so far altered that its fetal surface presents at the os, the uterine cavity behind it being occupied by a mass of blood (Fig. 256). When this occurs,

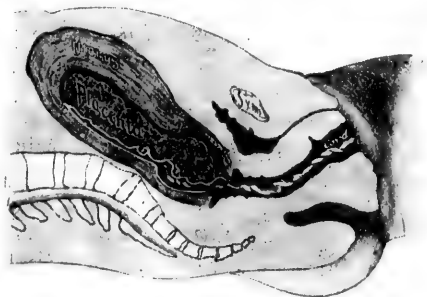


FIG. 255.—The more favorable mechanism of expulsion of the placenta (Varnier).

the placenta presents in so much more bulky a form that it is usually expelled so slowly and with so much difficulty that the process is not completed until the effused mass of blood attains sufficient size to redistend the uterus slightly,

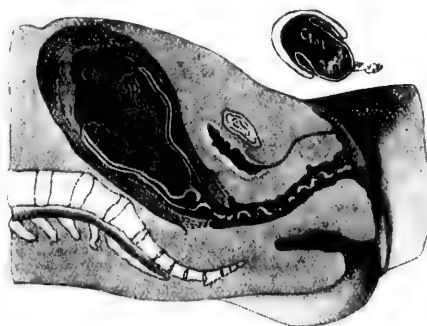


FIG. 256.—The less favorable of the common methods of expulsion of the placenta (Varnier).

and thus permit of the occurrence of more forcible contractions. The placenta is then expelled, not by the force of direct contact, but by an intra-uterine fluid-pressure exerted through the mass of effused blood.

This second form of the mechanism of the third stage of labor, though essentially normal, is much the less easy and favorable for the patient; although the amount of blood lost is not usually sufficient to effect any perceptible alteration in her pulse.

In either mechanism the elastic and collapsible nature of the membranes renders them less likely than the placenta to be thoroughly detached, and as the latter emerges through the hole in the membranes that corresponds with the os they are necessarily inverted, and, becoming detached by the traction due to the advance of the placenta, follow after it in a loose mass.

Management of the Third Stage of Labor.*—The inquiry naturally arises: How far is it within the power of the obstetrician to favor or to compel the occurrence of the mechanism first described? To this inquiry it may be answered that the maintenance of a careful watch upon the uterus by constant touch of the fundus through the abdominal wall, and the institution of rapid but light friction with the fingers upon the fundus during the first contraction, usually so far increase its duration and force as often to effect the complete separation of the placenta. Moreover, if this friction is persisted in throughout the succeeding period of relaxation, it will usually maintain sufficient contraction to prevent any considerable effusion, and secure separation during the first or the immediately succeeding pains. This most essential portion of the method of Credé should therefore uniformly be adopted.

The second and less favorable mechanism is probably safer for the patient than any manual method of removal of the placenta, but in case a delay in the third stage, notwithstanding the adoption of Credé's method of expulsion, should require the introduction of the hand, a digital intra-uterine examination should first be made, and if the placenta is found to present in the way shown in Figure 256, an effort should be made to reach the edge of the placenta with the finger. It may then be possible to draw the edge of the after-birth into the os, and thus permit its ready expulsion without the complete introduction of the hand.

D. Mechanism and Management of the Posterior Positions of Vertex Presentations.

Mechanism of Right-posterior Positions.—In the right-posterior positions of vertex presentations the head always enters the pelvis O. D. P.; it should invariably enter the inferior strait in a right-anterior position; but the process by which this rotation is accomplished is, unfortunately, so delicately balanced that it is always liable to a failure, and this, if it occurs, necessarily results in a persistence of the posterior position, which, though not incompatible with a natural delivery, is attended by greatly increased risks to both mother and child.

We have to consider, then, first, *the entrance of the head into the pelvis in posterior positions*; secondly, *the normal mechanism of the subsequent delivery by rotation*; and thirdly, *the (abnormal) mechanism of the delivery of a persistently posterior occiput*.

Labor in posterior positions is usually longer and more difficult than in anterior positions, for two reasons: first, because the entrance of the head into the pelvis is more difficult; and second, because, even under the most favorable circumstances, labor is sure to be lengthened by the more extended rotation of the occiput that is necessary to its completion.

The *difficult entrance of the head at the brim in occipito-posterior positions* is due to the existence of two factors, one of which is physiological, while the other is mechanical. The physiological factor is to be found in an irregular

* For the management of the first and second stages of normal labor, see page 367.

and imperfect action of the pains, that characterizes the first stage of labor in a large proportion of posterior positions. The exact cause of this well-marked feature of such cases is unknown. Probably it is a reflex phenomenon due to pressure, from the mechanical mal-adaptation shortly to be spoken of; but it is a fact that a long first stage, which is due to irregular, variable, and ineffective pains, is always suggestive of a posterior position.

The mechanical factor is due to the irregular shapes of the fetal head and the pelvic brim. If parallel diameters are drawn across the pelvic brim (Fig. 257), the one (A) from the right side of the sacral promontory to the right ilio-

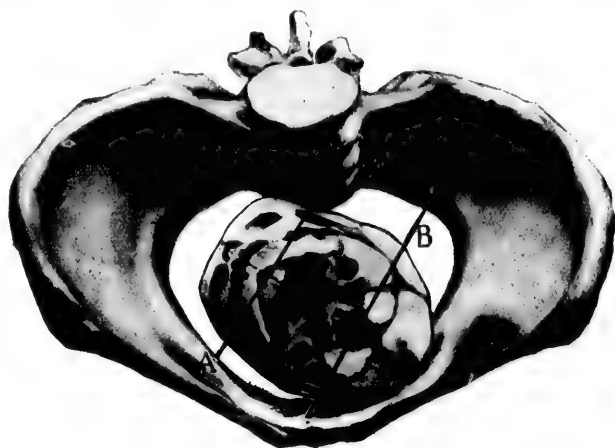


FIG. 257.—Adaptation between the fetal head and the brim of the pelvis in anterior positions of the occiput.

pectineal eminence, and the other (B) from the left sacro-iliac notch to the pubes, it will be seen that when the head enters O. L. A., the wide biparietal diameter of the head corresponds with the greater space afforded by B, the longer of these diameters; while the lesser bitemporal diameter is in correspondence with A, the shorter of these parallel diameters.

The entrance of the head is therefore mechanically easy in anterior positions; but, conversely, when the head enters O. D. P., its wide biparietal diameter is opposed to the narrow oblique space between the promontory and the ilio-pectineal eminence of the right side, while the narrow biparietal diameter is loosely fitted into the wide space afforded by the anterior portion of the pelvis (Fig. 258). Two factors of difficulty are thus produced: first, the widest portion of the fetal head finds itself in apposition with a narrow portion of the pelvis, and therefore requires a powerful driving impulse to force it through the brim; second, this retarded widest portion of the head is situated on the occipital end of the head lever, while the sincipital end is almost free. This situation, therefore, always tends toward a too rapid descent of the sinciput—that is, toward the production of extension—but the degree

of extension produced varies with the relative sizes of the pelvis and the head.

If the disproportion between the biparietal diameter of the head and the portion of the pelvis in which it finds itself (that is, A, Fig. 258) is not extremely great, the production of an extension sufficient to cause a light pressure of the forehead against the pubes may be enough to equalize the

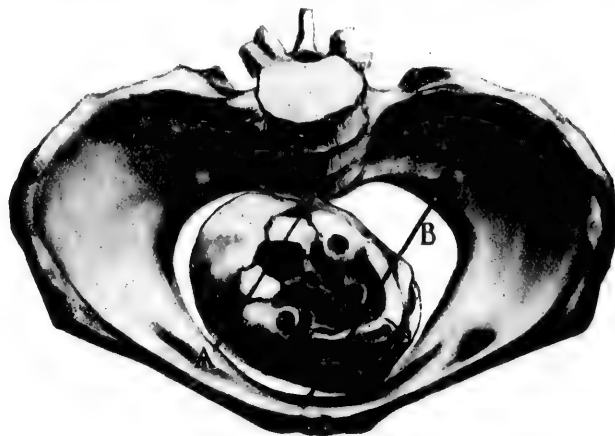


FIG. 258.—Adaptation between the fetal head and the brim of the pelvis in posterior positions of the occiput.

resistances at the opposite ends of the cephalic lever, and may thus permit the greater propulsive force applied to the occiput (see page 433) to accomplish its descent while the sinciput is still above the brim. The head in this case will enter the excavation in a fairly well flexed condition.

If the disproportion between the occiput and the posterior portion of the pelvis is more extreme, the process of extension will continue until the occipito-frontal diameter occupies the first oblique diameter of the brim. The head may then pass the brim, after long labor, in an extended position;* it may be arrested at the brim by becoming a brow presentation, or it may exceptionally be converted into a face presentation.

Passage of the Excavation.—After its escape from the superior strait the head occupies the first oblique diameter of the excavation O. D. P., and the accomplishment or non-accomplishment of the remainder of the labor by the normal mechanism of rotation depends wholly, and only, on the degree of flexion present.

Rotation in Well-flexed Right-posterior Positions.—When the occiput enters the excavation—that is, passes below the promontory—while the sinciput is still delayed in or above the brim, it occupies for the moment so roomy a posi-

* It will be remembered that the occipito-frontal diameter is too large to pass even the oblique diameters at the brim with ease.

tion that it is enabled to descend rapidly almost to the floor of the pelvis, while the sinciput, delayed by the pressure of the anterior pelvic wall, makes but slight progress. The occiput then lies between the sacrum and the right ischium, in the hollow made by the recession of the elastic sacro-sciatic ligaments—that is, in the deeper portion of the posterior groove of the right side of the pelvis—while the sinciput is pressed against the smooth and uniform surface of the upper part of the anterior portion of the lateral wall on the left side. As descent goes on the occiput follows the posterior groove forward under the pressure of the unyielding bony edge of the sacrum, which presses against its posterior surface; this motion is unopposed by the sinciput, which in thoroughly well flexed heads is still so high in the pelvis that it is free to turn backward over the smooth bony surface of the upper portion of the lateral wall (portion A, Fig. 217, A and B, Fig. 218). Rotation thus progresses smoothly, and usually rapidly, until the occiput reaches the spot at which the posterior and anterior grooves of the right side join, and thus assumes an anterior position. The sinciput, which has by this time become well posterior, now lies in the upper portion of the posterior groove of the left side. The head is now in an O. D. A. position in the lower portion of the pelvis,

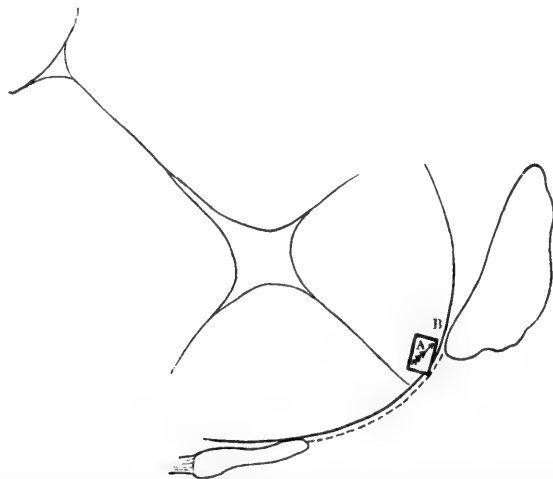


FIG. 259.—Diagram illustrating the possible reproduction of flexion in partly extended posterior positions of the occiput. The force of rotation is represented by the arrow A; the portion of that force which is applicable to flexion, by the line B.

and the remainder of the mechanism, including restitution, is exactly similar to that which would have obtained in an originally O. D. A. position (see pp. 430–440).

Mechanism of Rotation when the Head enters Poorly Flexed in Right-posterior Positions.—When more marked, but not extreme, extension occurs across the brim before the passage of the occiput, the release of the latter, as before, permits it to make a rapid descent until it is arrested by contact with

the pelvic floor; but at the time when the occiput begins to feel the forward impulse of the deep lower portion of the posterior groove of the right pelvic wall the sinciput is not, as before, in contact with the smooth surface of portion A of the left lateral wall, but has, on the contrary, already entered the upper portion of the anterior groove on that side. Under these circumstances rotation may exceptionally be accomplished. When this does happen the mechanism is as follows: As the occiput is urged forward, the posterior side of the sinciput is pressed firmly against the slightly rising edge of the upper portion of the anterior groove, and under favorable circumstances this increased pressure may result in flexion of the head in the manner illustrated in Figure 259, which is a horizontal section of the pelvis through the spot where the sinciput impinges against the lateral wall. The rotation force due to the forward motion of the occiput urges the sinciput backward in the direction of the force represented by the arrow A. If upon this arrow we construct the parallelogram of forces, we see that by the shunt of the shelving surfaces of the sinciput and the pelvic wall there is produced a small pressure (B) upon the sinciput that tends directly to flexion, and that may, under favorable circumstances, actually produce flexion to a degree sufficient to permit the sinciput to slip by on to the smooth surface of portion A (Fig. 217). The sinciput is free to then glide back into the posterior groove as the occiput moves forward, and the mechanism of rotation described above goes on as before.

This process, however, is mechanically so extremely difficult that it can occur only under the most favorable conditions—that is, when the adaptation is easy, when the pains are powerful, and, most important of all, when the loss of flexion is so extremely slight that but a slight change is needed to restore it.

Mechanism of Rotation when the Head enters Unflexed in Posterior Positions: the Mechanism of the Passage of the Excavation in Persistent Right-posterior Positions.—When the head passes the brim so far extended that the sinciput is as low, or nearly as low, in the pelvis as the occiput, the forehead reaches the deeper portion of the anterior groove at about the same time that the occiput reaches the deeper portion of the posterior groove. Both ends of the head are then urged to rotate forward by the forward trend of their respective grooves; since neither one can rotate forward unless the other turns back, there results a dead-lock which can be broken only by the intervention of art—that is, by a manual or an instrumental flexion of the head. In rare cases, however, this dead-lock may be avoided by the occurrence of a second and abnormal mechanism, by which the occiput is rotated directly backward into the hollow of the sacrum. This rotation can occur only when the adaptation between the head and the pelvis is exceptionally easy, when the sacrum is exceptionally hollow, and when its lateral concavity is but little marked. The occurrence of a backward rotation is then due to the fact that the posterior edge of the anterior groove, formed by the ischiatic spine, is more prominent than the corresponding portion of the posterior groove, formed by the edge of the sacrum. If, under these circumstances,

the occiput and the sinciput are at equal depths in the pelvis, it results that the sinciput is more firmly fixed in the anterior groove than is the occiput in the posterior; and if the adaptation is exceptionally easy or the lower portion of the sacrum is wanting in prominence, the occiput may be able to escape from the posterior groove and turn backward over the sacrum as the sinciput rotates forward. This escape of the occiput into the hollow of the sacrum usually so far diminishes the pressure on the occiput as to permit of its rapid advance, while the descent of the sinciput is still delayed by the normal resistances of the anterior wall of the pelvis. The rapid descent of the occiput as compared with the sinciput thus re-establishes flexion, with the head in a directly occipito-posterior position. Expulsion of the head in a persistently posterior position by the natural forces or by the aid of forceps is then possible, though the conditions are much less favorable than when the occiput is rotated forward, as may be seen by reference to Figure 260. On comparing



FIG. 260.—Expulsion of the head in persistently posterior positions of the occiput; mechanism of face to pubes delivery.

Figure 260 with Figure 251 it will be seen that when the occiput is anterior the curved axis of the child's head and body corresponds with the curved axis of the pelvis, but that when the occiput is posterior these curves are reversed upon each other, and that to effect the delivery in this position the uterine forces must alter the shape of the child by elongating the occiput, by compressing the sinciput, and by producing an exaggerated flexion until the normal curve of the fetal axis is reversed. Although the fetal head is surprisingly tolerant of the excessive compression necessary for this change of shape, the process always results in the stillbirth of a large proportion of the children; while the prominence of the occiput, even after the most extreme moulding, always exposes the soft tissues of the pelvic floor to a degree of tension that almost invariably results in deep laceration of these structures during the stage of expulsion. The expulsion of a persistent occiput posterior, moreover, always requires, in addition to lax adaptation, the presence of very

powerful uterine contractions or the application of powerful traction by the forceps; and even when these conditions are present the process is a long one.

The head remains in position until the processes of the change in its shape and the production of extreme flexion are sufficiently far advanced to permit the occiput to travel downward along the median line of the posterior wall under the influence of the pressure from above. The region of the small fontanelle finally appears at the vulva, and the perineum retracts, or, more commonly, tears across the occiput to the base of the neck. The occipital end of the head is then free from pressure, while the sincipital end is still exposed to the driving force of the uterine contractions. The excess of pressure upon the sincipital end of the head then causes extension, by which the forehead, the eyes, the nose, and the chin successively appear under the arch, while the occiput swings backward, and the head is born by extension (Fig. 260).

Restitution.—During the expulsion of the head the shoulders enter in the second oblique diameter, and the rotation of the left (the anterior) shoulder to

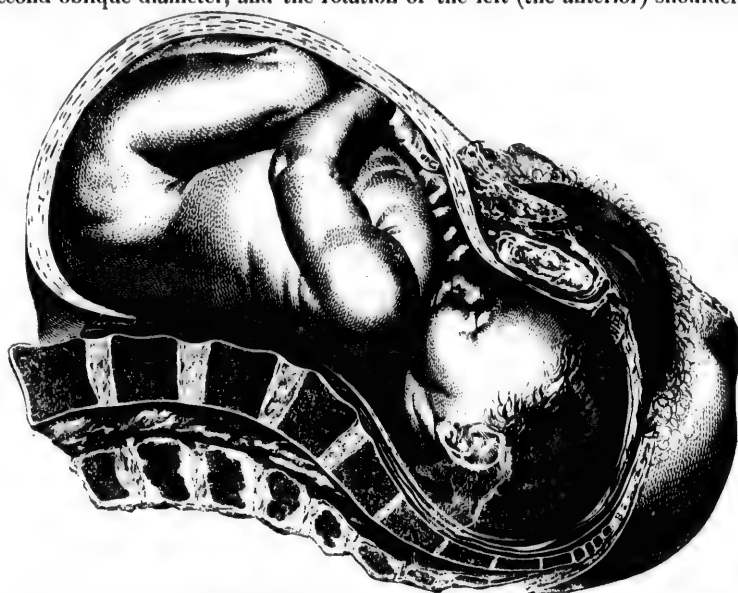


FIG. 261.—Occipito-posterior position, with the head beginning to distend the pelvic floor (Smellie).

the arch produces an external restitution to the right, in accordance with the general law that external rotation or restitution restores the head to its original position. Abnormal or so-called "super-rotation" is, however, of especially common occurrence in these cases.

Summary.—In reviewing the mechanism of posterior positions it is at once apparent that the whole key to the situation is to be found in the degree of flexion presented—that the better the flexion the more certain and the more rapid is the execution of the normal and most favorable mechanism. It is an

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established fact in practice that in the comparatively few cases in which good flexion is established at the start and maintained to the end, posterior labor is hardly less favorable than anterior; and that the degree of difficulty increases as the degree and persistence of flexion decrease, until we reach the fact that when flexion is lost and is not promptly restored by art, posterior positions invariably yield long, difficult, and exhausting labors for the mother, and a large proportion of stillbirths among the children. It may safely be said that there is no variety of labor in which easily-avoided ill results are so commonly incurred as in posterior positions of the vertex; and there is certainly no subject in obstetrics that better deserves the attention of the student than the means of detecting extension and of preserving or re-establishing flexion in these cases. *α*

Mechanism of Left-posterior Positions.—Of the mechanism of O. L. P. positions it is only necessary to say that it differs from that of O. D. P. positions simply in the substitution of one side of the pelvis for the other, and in the fact that failure of rotation is more common in left positions.

Management of Labor in Posterior Positions of the Vertex.—*Prophylaxis.*—Since posterior labor is so much less favorable than anterior, it is evident that every effort should be made to prevent the occurrence of posterior positions, or, when they do occur, to convert them into anterior positions before the occurrence of labor or during its early stages. We are, fortunately, able to effect this end in the great majority of cases, provided the position is diagnosed before the rupture of the membranes or the engagement of the head. For this reason, if for no other, the obstetrician should in every case endeavor to ascertain the position of the fetus by making an abdominal palpation some days before the advent of labor. If a posterior position is discovered at this time, it is usually possible to rectify it by postural treatment of the patient.

If the patient is placed in the knee-chest position, the anterior wall and the fundus are the lowest portions of the uterus. So long as the patient remains in this position there is a tendency for the child to sag away from the brim under the influence of gravity; and since the recession of the head from the brim leaves the child free to turn upon its own axis, while the presence of the spinal column makes the dorsal side the heavier, there is also a tendency toward a rotation of the fetus as a whole until its dorsum is in apposition to the anterior wall of the uterus.

The woman should in such cases be instructed to assume the knee-chest posture several times daily during the last few weeks of pregnancy, to remain as long in this position as is possible without fatigue, and, on relinquishing it, to recline on the right side for a short time before rising, in the hope that as the child's head again settles down against the brim it may become fixed in an anterior position.

The enlarged abdomen of the gravida at term may prevent the assumption of the true genu-pectoral position and compel her to adopt the knee-elbow attitude; but in either event it is essential that the abdomen should be free from

pressure against either the bed or the thighs of the patient ; that is, the thighs should be vertical (Fig. 262).

The postural treatment is especially powerful when instituted before any labor-pains have occurred. If this treatment is conscientiously carried out for several days, the physician will almost surely find the position anterior when summoned to the patient in labor.

Even if the patient is not seen until labor is present, it is still worth while to adopt a postural treatment so long as the membranes are unruptured and the head is unengaged. The patient should then be encouraged to maintain this position so long as her strength permits, or until a vaginal examination without alteration of her attitude demonstrates the fact that rotation has occurred. She should then be placed in the latero-prone position upon the side to which the occiput is directed, and should remain in that position until the head is firmly engaged in the new position. Should the head, after

once becoming anterior, show any tendency to revert to the posterior position, it may even be wise to rupture the membranes in order to prevent any such reversion.

Should the postural treatment fail, no special treatment is necessary until after the rupture of the membranes has occurred ; but both before and after rupture frequent examinations are advised, in order to detect early any tendency to the production of marked extension.

Passage of the Superior Strait.—In the majority of cases the head in posterior positions passes the superior strait by the natural efforts only after some delay, and often only after the occurrence of some extension and of considerable moulding of the head.

The attitude of the physician should be determined by the degree of extension presented. When the extension is not extreme, he should not be alarmed by a failure of progress, but should avoid interference, and expect the best results so long as the condition of both patients remains good.

When extension becomes so extreme that the eyebrows are below the brim of the pelvis, there is but little prospect that the head will pass the superior strait by the natural efforts, and unless active progress is present it is wise, after a single hour has passed without alteration of the condition, to abandon the expectant method of treatment and resort at once to the operative treatment of a high arrest of the posterior occiput.

Operative treatment at the superior strait subdivides itself into the operative re-establishment of flexion and the delivery through the superior strait of the flexed but arrested head.

Operative Flexion.—If, at the time when operative flexion becomes neces-

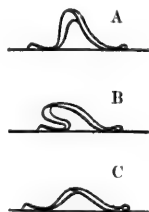


FIG. 262.—Correct (A) and incorrect (B and C) methods of assuming the genu-pectoral position.

sary, the membranes are still intact, it may occasionally be possible to raise the forehead by making pressure upon it with two fingers placed within the cervix, the woman being in the recumbent or knee-chest position, in order to afford the assistance of gravity to the efforts of the accoucheur. Since it is impossible, however, to obtain complete flexion of the head in this way, and since the extension is almost certain to recur if no further change is made, it is essential that the head as a whole should be freed from the brim by pressure upon the vertex, after flexion has been secured, in the hope that on its entrance it may be better situated, and may thus be able to maintain its flexion.

Should extension again recur, it is best to etherize the patient, introduce the hand into the vagina, and dilate the os manually to a degree sufficient to permit the passage of the half hand within the uterus. Should the membranes be ruptured at the time when interference is decided upon, this must usually be the first manœuvre. When sufficient dilatation has been attained, the half hand should be passed within the os until the fingers cover the forehead, which should then be pressed gently upward until complete flexion has been secured and the head has been freed from the brim. The hand should then be withdrawn, the fingers placed as high upon the forehead as possible in order to maintain flexion, and the head forced into the brim by external pressure. The ether should be removed, and the fingers should maintain pressure upon the anterior portion of the head until a firm engagement in a flexed position has been effected by the efforts of the uterus. Should extension become re-established, an operative delivery of the head is necessary.

Operative Delivery of a High Arrest of the Posterior Occiput.—If extension is present, flexion should be established by the introduction of the half hand. Three methods of delivery are then possible: The child may at once be turned, the head may be rotated manually and forceps applied to the anterior occiput, or forceps may be used while the occiput is still posterior.

The latter method is to be recommended only when the other methods are, for one reason or another, contra-indicated or impossible, and the choice ordinarily rests between the procedures of a manual rotation of the occiput to the front with a subsequent application of the forceps, and version.

Manual rotation and the application of forceps is a difficult, and version in normal pelves is an easy, operation. The head after manual rotation not infrequently returns to its original position during the manipulations incident to the application of the blades, and in any event it is necessary to apply the forceps to the head when freely movable above the brim, which operation is always difficult. The writer believes, however, that after the forceps has successfully been applied to the head in an anterior position, an extraction with it is less dangerous to the soft parts of the mother than is the extraction of an after-coming head; the forceps operation should therefore, in his opinion, be chosen by those who are thoroughly skilful in the use of the instrument, but the primary performance of version should be elected by operators of small experience.

Should manual rotation and the use of forceps be decided upon, the whole

hand should be passed into the uterus and the head be raised gently until the whole surface of the hand can be applied to the forehead, the fingers lying over the face of the child; whereupon the hand and the forearm of the operator should be rotated with the head until the occiput is well anterior to, and even, if possible, to the left of, the median line. During the introduction of the hand careful counter-pressure must be made at the fundus by an assistant or by the other hand of the operator, and during the rotation the external hand must be used to promote the rotation of the trunk. The rotation should always be slow and be procured with the utmost gentleness. Unless the rotation of the trunk accompanies that of the body, the head will return to its original position as soon as it is free from pressure. In difficult cases it may occasionally be permissible to apply the internal fingers to the shoulder of the child to promote this rotation. The whole manœuvre is frequently so difficult that, unless the waters have been but recently evacuated, it should not be attempted until a fair experience in version has furnished the operator with some adroitness in intra-uterine manipulations.

After rotation has been effected the head should be urged into the brim by counter-pressure upon the fundus, and it should be maintained in position by gentle abdominal pressure upon the head itself, from the hands of an assistant, while the forceps application is made. The forceps should be applied, if possible, to the sides of the head, and, as in all high operations, the use of an axis-traction instrument is to be recommended.

If *version* is decided upon, the head should be flexed before it is raised, as this always requires less force than an attempt to raise the extended head.

If version is absolutely contra-indicated and manual rotation fails, an attempt should be made to bring the head through the superior strait by the *application of forceps without alteration of the position*; but as a preliminary even to this operation an extended head should gently be flexed.

In the use of forceps while the occiput is still posterior, it is inadvisable to make any attempt to apply the blades to the sides of the head, as the position of the parietal bosses in the narrow space between the ilio-pectineal eminence and the promontory makes it extremely difficult to adjust the forceps to the ends of the biparietal diameter. Even when it is so adjusted a very slight forward inclination of the line of traction may cause the forceps to slip forward along the head to the temporal region. In this position the forceps is extremely likely to slip from the head altogether; even if the forceps holds its position, the sole and necessary result of traction is a reproduction of the extension, which, of course, results in an arrest, or at least requires the use of increased and unnecessary force. The blades should therefore be applied to the sides of the pelvis, where they will take an oblique grip upon the head. This application is always very difficult, and the operation too frequently results in a fracture of the skull or in the birth of a stillborn child from cranial compression. As soon as the head has passed the brim the forceps should be removed; if necessary, the forceps may be reapplied in the manner shortly to be recommended for the operative treatment of the low head in posterior positions.

Management of the Passage of the Excavation in Posterior Positions.—*Flexion.*—As was said in the discussion of the mechanism of posterior positions, the maintenance of complete flexion is the first and most essential condition of the progress of the head through the excavation. It follows that the maintenance of flexion when possible, and its re-establishment when it has been lost, must demand throughout the case the most careful attention from the obstetrician.

When the adaptation is easy and good flexion is present from the start, descent and rotation to an anterior position are sometimes so quickly performed that no assistance is needed; but in a large proportion of cases the head enters the excavation in a condition of partial extension, and in such cases an early adoption of certain very simple measures frequently makes the difference between difficult and easy labors. The various expedients which may be used to promote or to re-establish flexion form, then, the first and most important division of the treatment of the low head in posterior positions; but, since it not infrequently happens that even a well-flexed head fails to rotate from over-tightness of adaptation, from relative inefficiency of the pains, or from minor variations in the shape of the head and the pelvis, it is necessary to add thereto a second division, which consists of the expedients that may be employed to favor or to produce rotation during extraction, whenever, from any cause, a well-flexed head is arrested in a posterior position in the excavation.

Maintenance of Flexion.—Unless progress goes on with unusual rapidity, the maintenance of flexion by counter-pressure should be undertaken as soon as the head has entered the excavation and the forehead is within easy reach. As soon as the degree of descent permits, the fingers should be placed against the frontal bones as far forward of the large fontanelle as the pelvic space allows, and any further descent of the sinciput should be retarded by a maintenance of pressure against the forehead throughout the whole of each pain until the occurrence of rotation carries the frontal bones backward and out of the reach of the fingers. In this process a simple retardation of the descent of the sinciput is all that is to be aimed at or desired, since flexion is supposed to be already present, and its maintenance is all that is needed. This maintenance of flexion, which is unusually easy, is always a very much more simple matter than is an attempt to raise the forehead by pressure after extension has once occurred. If this precaution is carefully observed from the start, loss of flexion is extremely rare, and a recourse to the more heroic methods required for its re-establishment may usually be avoided.

Re-establishment of Flexion.—When extension occurs, it must be reduced before any further progress is possible. Flexion may be re-established either by pushing the sinciput up, by drawing the occiput down, or by a combination of both methods. The forehead may occasionally be made to recede by pressure upon the frontal bones with the fingers; it should then be held in position until the uterine efforts have effected complete flexion by descent of the occiput, and until rotation has occurred. This method, the simplest and safest, is, however, possible only in very easy cases.

It is occasionally possible to reinforce this method by hooking the fingers of the hand around the occiput, and thus drawing down upon the occiput with one hand while the sinciput is pressed up by the other hand. This method is possible only when the extended head is very low and the soft tissues of the outlet are very lax; in the majority of cases in which extension has fully been established it is necessary to resort to instrumental methods.

The vectis (Fig. 263), which was the precursor of the forceps, was originally used to promote the descent of the head by the application of leverage motions

to the sides of the head in alternation. The vectis is never used to-day except for the reduction of extension, and, in the opinion of the writer, cannot be recommended even for this purpose, since, in the first place, its efficiency depends on its possession of an exaggerated cephalic curve which renders its introduction difficult, and, in the second place, it can rarely be prevented from slipping, without the use of a degree of force which exposes both the vagina of the mother and the scalp of the child to serious risks of laceration. If employed, the vectis is passed around the occiput and is used to draw it down, while the delay of the sinciput is entrusted to the friction of the pelvic walls or to counter-pressure by the fingers. For this purpose the hand of an assistant must be utilized, since the employment of the



FIG. 263.—The vectis.

vectis always requires both hands; that is, while one hand makes traction on the handle of the vectis, the fingers of the other hand must always be placed between the vagina and the instrument to protect the tissues from laceration.

Reversed Forceps.—A far better operation, when manual efforts at flexion have failed, is to be found in the application of reversed forceps. This operation is in reality a mere extension of the ancient principle that the tips of the forceps should always be directed toward the leading point on the presenting part; but when the forceps is applied to an extended head in a posterior position with the tips directed posteriorly, its grasp is directed so far toward the occipital end that the instrument is almost certain to slip after flexion has occurred. It is therefore important to remember that this application should be utilized only for the production of flexion, that during each traction the fingers of the unemployed hand should carefully note the motions of the head, and that as soon as flexion has been established the blades should be removed, if necessary being reapplied for the delivery of the head in the manner recommended for the delivery of a well-flexed head in posterior positions.

Technique of the Application of Reversed Forceps.—The forceps should be placed outside the vulva, in the position in which they are to lie when applied to the head—that is, with the transverse axis of the blades at right angles to

the sagittal suture, and with the tips directed backward. If the lock is of the ordinary form, the handle of that blade which would be the left in the ordinary position should be held in the right hand, and, under the guidance of two fingers of the left hand, should be inserted into the vagina and passed into position as near as possible to the occipital end of the head (Fig. 264).



FIG. 264.—The application of reversed forceps. The arrow indicates the effect of the forceps in promoting the descent of the occiput while the sinciput is delayed by friction against the anterior pelvic wall.

The other blade should be adjusted to correspond with its fellow, and simple traction upon the handles should be made in the direction of the handles, all leverage motions being avoided. The force of the instrument is then directed against the occipital end of the head alone; the sinciput is delayed by the friction of the pelvic walls, while the occiput descends under the force of traction, and flexion results.

As soon as the small fontanelle has been brought to the centre of the pelvis—that is, when the head has been flexed—the forceps should be removed and the process of rotation be entrusted to nature, since lacerations of the vagina are far less often produced when rotation is effected by the uterine force than when it is procured by instrumental means; unless, indeed, the condition of the patient necessitates an immediate delivery.

Low Forceps in Well-flexed Heads in Posterior Positions.—When rotation fails notwithstanding the presence of good flexion—that is, when a well-flexed head is delayed in a posterior position until the signs of exhaustion occur—this failure is usually the result of a relative want of *vis-a-tergo*, which must be compensated for by the substitution of the *vis-a-fronte* of the forceps; but it is the first essential to success in this operation that the instrument should be so applied that its presence in the vagina offers no impediment to the rotation of the head. If in this position of the head the forceps is applied to the sides of the pelvis, its oblique grasp upon the forehead and the occiput will almost certainly prevent rotation; while, even if it is applied to the sides of the head, it is liable to cause extension and consequent delay, with laceration

of the perineum, and frequently the death of the fetus, unless special precautions are taken to ensure its grasping the occiput.

So long as the occiput is distinctly posterior to the transverse line of the pelvis, the forceps should be applied to the sides of the head with the concavity of the pelvic curve toward the forehead—that is, with the tips anterior; but care should be taken during the application of the blades to keep the handles well raised, or, to use a better expression, to direct the tips far backward into the pelvis, in order to ensure their grasping the occiput and thus promoting rather than retarding flexion during the tractions. The tractions should be directed as far backward as the perineum will allow, at least until rotation has occurred; since it is sometimes difficult to secure this line of traction in the ordinary position of the hands, it is often well, in the extraction of posterior positions, to place the left hand upon the shanks of the instrument near the vulva, and with that hand draw backward while the right hand steadies the extreme end of the handles.

It must not be forgotten that the maintenance of flexion and the consequent production of rotation are essential objects of this first application, since descent is dependent on them.

The production of forced rotation by a rotative movement of the handles of the forceps is so extremely dangerous to the soft parts of the mother as to be permissible to none but the most experienced operators. The operator who has really acquired sufficient skill to justify such a manœuvre will infallibly have acquired so active an impression of its dangers as to use it with the most



FIG. 265.—Lateral motion of the handles of the curved forceps during the rotation of a posterior position of the head: A, position of the handles when first applied; B, position of the handles after partial rotation has occurred.

extreme care; but, though an active rotation force is not permissible, it is always proper, and indeed necessary to success, that the operator should avoid preventing rotation. He should know exactly the motion the handles will make during the rotation of the head, as that occurs under the guidance of the pelvic grooves, and he should be constantly on the watch to promote and favor this motion.

In this connection it must be remembered that when rotation occurs it will be in the axis of the blades and not in that of the handles, so that as the blades rotate their handles will move in a laterally circular direction such as is illustrated in Figure 265. If a good pair of straight forceps is at hand, it

is much the better instrument for low operations in posterior positions, since with it no such lateral motion of the handles occurs, and the avoidance of the necessity of watching for it greatly simplifies the operation.

At the conclusion of each traction the handles of the forceps should be separated slightly, since, if this is done, the head not infrequently rotates to an anterior position within the blades. This manœuvre is especially useful when the original application of the forceps has been slightly inaccurate, and the head is, in consequence, not grasped exactly on its sides. A careful digital examination should always be made at the conclusion of each traction, in order to note exactly the mechanism which is going on, to become aware of rotation as soon as it occurs, and to detect any tendency to extension which may have followed a faulty application of the forceps.

As soon as the position is slightly anterior, or even when it becomes transverse, the forceps should be removed and reapplied to the sides of the head, but this time with the concavity of the pelvic curve toward the occiput, since any further rotation with the blades in the former position would carry them into the position of the reversed forceps, in which the grasp is unsatisfactory and the danger of laceration is great from the too close approach of the tips to the posterior wall of the vagina. The tractions should again be intermittent, rotation of the forceps with the head should be favored, and the compression should be intermitted during the intervals between the tractions, to permit the head to rotate within the blades. When the head has reached the O. D. A. position the forceps should again be removed, and reapplied in the ordinary way, unless the application is at that time wholly unsatisfactory. The operation as a whole is vastly more difficult than is an extraction in an anterior position.

Delivery in Persistently Posterior Positions.—When, from any cause, the proper maintenance of flexion has been neglected, and the occiput has settled into the hollow of the sacrum—that is, where it has become directly posterior—a delivery “face to pubes” is all that can be hoped for. Under these circumstances delivery by the natural efforts necessarily implies the presence of an unusually powerful and active uterus. It is necessary for the pains to force the head into extreme flexion, to mould it into a much-changed shape, and to distend the soft tissues to an extreme degree; and the *vis-a-tergo* of the uterus must usually be reinforced, before the process is completed, by the *vis-a-fronte* of the forceps.

The first duty of the obstetrician is to establish an extreme flexion by pressure on the forehead with the fingers; it will then be maintained by nature if the uterus is powerful enough to effect an unaided delivery. In this case an attempt to preserve the perineum by keeping the occiput well forward against the pubes is his only other duty; and as the necessary change in the shape of the head is to be most safely effected by slow moulding—that is, during a long second stage—he should be patient and loath to interfere; indeed, in these cases the use of the forceps is never warranted unless the signs of exhaustion of one or the other patient are clearly present and increasing and progress has ceased.

If the *forceps* must be used, it should be applied to the sides of the head, and the extraction should be effected by means of the so-called "pump-handle traction." The tractions should at first be directed well backward until the perineum distends, in order to draw the occiput downward along the posterior pelvic wall, and then should sweep forward, in order to draw it forward over the pelvic floor to the vulva and the arch of the pubes. These tractions should be gentle and intermittent, in order to encourage a slow moulding of the head,* and the forward direction should be maintained until the small fontanelle appears at the fourchette and the perineum retracts along the neck. The handles of the forceps should then be moved backward, but without intermission of the traction, in order to favor the appearance of the face from under the pubic arch by extension as in natural labor.

2. FACE PRESENTATIONS.

Frequency.—A face presentation is not a very common anomaly. Pinard found 320 face cases out of 81,711 deliveries at the Paris Maternité—a frequency of about 1 in 250. At Guy's Hospital Lying-in Charity, London, there was a frequency of 1 in 276, or .36 per cent. out of 23,591 cases of labor. Churchill analyzed about 250,000 cases, and found that face presentations averaged 1 in 231. Collins at the Dublin Rotunda found the frequency to be 1 in 497. Spiegelberg thought that in Germany it was 1 in 324.

Relative Frequency of the Positions.—M. L. A. is but very slightly more frequent than M. D. P. M. D. A. and M. L. P. are very rarely seen.

Etiology.—Face presentations are, of course, produced by the extension of vertex presentations at or just before the beginning of labor, and every face presentation has therefore passed through the stage of brow before becoming a face presentation. Many factors may contribute to the production of this extension, and it is probable that the etiology of the anomaly varies widely in different cases. It may be originated by an *abnormal shape of the head*, by an *obliquity or abnormality of the uterus*, by *small tumors in or about the pelvic brim*, by a *deformity of the pelvis*, or by an over-tight adaptation between the head and the brim in a *posterior position of the vertex*.

Undue Length of the Hind-head.—Any abnormal prominence of the occiput necessarily lengthens the short arm of the cephalic lever, and therefore tends to the production of extension. The presence of such an anomaly would undoubtedly predispose to a face presentation, and cases have been reported in which it was apparently the sole cause; but in the majority of face cases the head is found to be of normal shape after the moulding of labor has passed away, and was therefore probably normal at the beginning of labor.

Obliquity or Abnormality of the Uterus.—An obliquity of the uterine axis by which the fundus is inclined to the side on which lies the back of the child tends to roll the condyles to the opposite side of the pelvis by altering the

* Since the chief danger in this operation is that of inhibiting the life of the fetus by compression of its skull against the pubes, it is well to have the fetal heart watched by an assistant, and to regulate the force of the tractions by the effect produced upon its beat.

direction of the uterine force (Fig. 266), in which the condyles are urged (in the direction of the arrow) by the uterus, and thus produces extension. Again, any irregularity in the contour of the uterine wall on the side to which the occiput is directed—for example, a cicatrix or a localized tonic constriction—may delay its progress and so produce extension.

Small Tumors in the Brim.—A tumor which impedes the advance of the occiput, but does not interfere with the sinciput, may be the cause of a face presentation.

Pelvic Deformities.—The minor grades of flattened pelvis in which moderate extension at the brim is normally present (see *Dystocia*) are a frequent cause of face presentations.

Tight Adaptation in the Posterior Positions of Vertex Presentations.—We have seen (p. 443) that there is a marked tendency to the production of extension at the brim in O. D. P. and O. L. P. positions. That this is a frequent cause of face presentation is shown by the fact that, although an O. D. P. occurs but about once in every four vertex labors, the results of its extension—that is, an M. L. A.—make up nearly one-half of all face labors.

Diagnosis.—On *abdominal examination* the fetal limbs, the heart,* and the least accessible portion of the head are found on the same side. On *vaginal examination* with the finger, the pointed chin, the mouth with its maxillary processes and the tongue, the nostrils, the bridge of the nose, the eyes, and the supraorbital ridges should be found and recognized. The position is determined by the position of the chin.

Prognosis.—The prognosis in face presentations for both mother and child is always somewhat worse than in vertex labor, but it varies greatly in accordance with the position of the chin, the prognosis of anterior positions being vastly better than that of posterior positions. The mortality of face presentations varies also between extremely wide limits, in accordance with the variations in the adaptation between the head and the pelvis, and more especially with the degree of ossification of the fetal head.

When the chin is *anterior*, when the adaptation between the head and the pelvis is moderately easy, and the fetal head is so soft as to permit of an easy production of the necessary change of shape, face labor is apt to be rapid. The prognosis for the mother is then unaltered from that of good normal labor, and the prognosis for the child is but little worse; but this statement is true only when the conditions are such that there is rapid progress throughout the

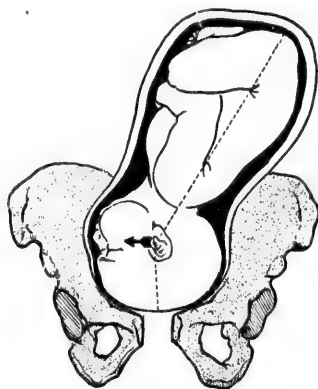


FIG. 266.—Manner in which an obliquity of the uterine axis may produce a face presentation.

* In face presentations the heart is heard over the ventral side of the chest.

second stage: with the supervention of any delay the prognosis for the child becomes decidedly poor, while at the same time the mother's prospects are rendered less good by the risks of laceration during rotation that are always involved in a difficult or operative delivery of the face.

In *posterior* positions of the chin the prognosis for the child is always poor, since under the most favorable circumstances it is necessarily exposed to the utmost danger, both from the marked compression of the cranium against the symphysis that invariably occurs and from the great tension upon the tissues of the neck that is implied in the extreme extension necessary to excite rotation in posterior positions of the face. With any but the most extremely favorable conditions the prognosis for the child in posterior positions of the face is almost necessarily fatal, while that for the mother is complicated by the probability of extensive lacerations. In the large majority of such cases rotation fails, and the child's case is then practically hopeless, since no instance has yet been recorded in which the child's life was preserved during the extraction of a persistently posterior position of the face.

Mechanism and Management of Face Presentations.

Mechanism of Face Presentations.—In the mechanism of face presentations the chin plays the same *role* that the occiput does in vertex labor. Rotation is as necessary to expulsion in the one case as in the other, and the occurrence of rotation depends on the fact that under normal conditions the chin enters more deeply into the pelvis than the most prominent point upon the other side

of the head, which in this case is that portion of the forehead immediately anterior to the bregma. This deeper entrance of the chin is in face presentation secured only by the existence of complete extension, and extension is therefore as important to progress during the second stage of face labor as is flexion during the second stage of vertex labor.

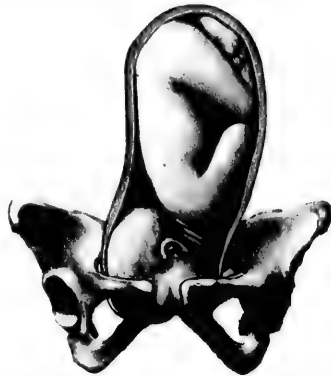


FIG. 267.—Presentation of the face at the pelvic brim.

unengaged, and becomes a face presentation only during the passage of the brim. By reference to Figure 267, which represents the position of the head during the passage of the brim by a face presentation, it will be seen that after the point of the chin has passed the pelvic brim the ventral side of the head and the neck is so shaped as to offer but little opportunity for the engendering of friction against the pelvic wall, while the

Mechanism of Face Presentations, M. L. A.—Fully-developed face presentations at the beginning of labor are comparatively rare. The face commonly starts as a vertex, passes through the stage of a brow while still

shape of the projecting forehead and bregmatic region is such as to ensure firm pressure between them and that part of the pelvis opposite. The position of the head brings its articulation with the spinal column far out to the



FIG. 268.—Face presentation at outlet after rotation (Smellie).

ventral side of the head, and we have then the pressure of the propelling force concentrated far out to one side in the head, while the resisting force of friction against the pelvic walls is exerted almost wholly upon the other side; hence good extension is the rule in face labor. The existence of complete extension,



FIG. 269.—Configuration of the fetal head after its delivery as a face presentation.

FIG. 270.—Configuration of the fetal head after its delivery as a vertex presentation.

however, places so great a strain upon the tissues of the neck that its production is usually accomplished slowly; and the diameter which must occupy the brim as the head descends—namely, the cervico-bregmatic (Fig. 267)—is so

large that with reasonably tight adaptation the descent of the face is usually accomplished at the expense of considerable moulding of the head (Fig. 269).

The cervico-bregmatic diameter of the head is so far behind the leading point, the chin, that by the time the head is free from the superior strait—that is, when this great diameter passes it—the chin is already deep in the pelvis, and does, indeed, by this time occupy the deepest portion of the anterior groove of the left lateral wall. At this point there is often a temporary dead-lock, since the great elongation of the head may still leave the region of the sagittal suture in the sacro-iliac notch, where it is prevented by the promontory from turning backward, although the chin is being urged strongly forward by the lower portion of the anterior groove.

Rotation can then occur only when the propelling force is sufficiently strong to crowd the chin downward to the lowest possible point, and may even require a further lateral moulding of the head under the pressure of the promontory against the projecting occiput.

As soon as the occiput slips under the promontory rotation promptly occurs. The chin swings under the pubic arch (Fig. 268), and the mouth, the nose, the eyes, and the forehead successively appear at the fourchette. When the angle of the jaw rests against the descending rami of the pubes, the chin and the face become wholly freed from pressure, while the occiput is still exposed to the propelling power of the uterine force from above. The chin then sweeps upward, and as the occiput continues to progress, the bregma, the small fontanelle, and the occiput successively appear at the fourchette, and the head emerges by flexion.

The mechanism of face labor is, then, extension, descent, rotation, and birth by flexion. Restitution carries the chin to the side to which it was originally directed during the expulsion of the shoulders. The *mechanism of M. D. A.* labor is, of course, similar to that of M. L. A.

The Mechanism of Posterior Face Presentations, M. D. P.—The chin enters the posterior groove at the brim, and should travel forward along its course; but even when extension is complete the production of so extensive a rotation as is necessary to bring the chin to the front is rendered extremely difficult by the marked obstacle afforded to its performance by the resistance of the very prominent bregmatic region, which, notwithstanding its size (Fig. 271), must be made to travel backward along the whole left lateral surface of the brim—a motion possible only when the propelling forces are sufficiently powerful and the head is sufficiently soft to permit the production of a very extreme degree of moulding of the head. When rotation has once carried the chin into an anterior position, the mechanism, of course, is that of a primary M. D. A. No separate description of the M. L. P. mechanism need be given.

Management of Face Presentations.—Management of Face Presentations at the Brim.—The measures which must be considered in the management of face presentations when detected while the child is still in or above the brim are as follows: The case may be left to *nature*; an attempt may be made to raise the

chin, and so restore a vertex presentation by *manual flexion of the head*, after which it may be left to nature or be delivered by the forceps; *forceps* may be applied to the face as such, or the case may at once be delivered by *version*.

Natural Labor.—The first expedient, that of leaving the case to the care of nature, is applicable only under one set of circumstances. When the chin



FIG. 271.—Posterior position of the face deeply engaged in the pelvis (Smellie).

is anterior; when the woman is a multipara who has had a succession of easy labors; if the accoucheur is able to satisfy himself by a thorough examination that the soft parts are soft and dilatable, that the pelvis is ample, and that the child is small, the latter point having been determined not only by palpation of the abdomen, but also by palpation of the head with the half hand introduced into the vagina; when the uterus is powerful and the pains are frequent; and, finally, when no pathological complication is present,—it is often wise to adopt a conservative policy; but the consequences of delay are so serious even in anterior positions of the face, and the prediction of an easy labor is always so difficult, that the obstetrician should feel that in making this prediction and adopting a policy of inaction he is taking a very grave responsibility. When the chin is posterior, or when, in anterior positions, the conditions are anything but the most favorable, it should be the rule that the detection of a face presentation at the brim is to be followed by immediate interference.

Interference at the Brim.—The choice of methods rests between *manual flexion of the head* into a vertex presentation, *version*, and the application of *forceps to the face*.

The choice between version and the production of a head presentation by manual flexion rests mainly on the position of the chin. If the chin is posterior, flexion of the head will result in the production of an anterior position

of the vertex—the most favorable position for a subsequent delivery by nature or for an extraction by the forceps; if the chin is anterior, flexion can produce only the unfavorable posterior position of the vertex.

In posterior positions of the chin manual flexion should ordinarily be the first expedient, and the head, when flexed, should be urged into the brim by external pressure with the hand, in the hope that it may become engaged in this position under the influence of the pains, after which the case should, of course, be left to nature; but if an engagement does not follow promptly, it is best to apply forceps at once, since the conditions which originally produced the face presentation may usually be relied upon to reproduce it. If the manual reproduction of a vertex presentation proves difficult or impossible, the attempt should be abandoned and version be performed.

If the chin is anterior, flexion of the head would result in the production of a posterior position of the vertex; and since, as has been seen, posterior positions of the vertex at the brim are usually best treated, when interference is necessary, by a resort to version, it follows that in anterior positions of the chin, when interference is necessary, a primary version is the operation of choice. When in such cases a version is contra-indicated, the choice lies between an application of the forceps to the face and a manual flexion into a posterior position of the vertex, to be followed by an attempt at a manual rotation of the occiput to the front and the application of forceps. If the conditions are such as to render this latter operation possible, it is generally preferable to the use of forceps to the face; but since the conditions which contra-indicate version very generally render manual rotation of the head difficult or impossible, it will sometimes be necessary to resort in such cases to the use of forceps to the face.

The use of forceps to the face at the brim is always a difficult operation. The delivery of the child through the brim without injury to either mother or child can be accomplished only by the utmost accuracy in the adjustment of the blades; and even in anterior positions the prognosis is serious. The use of forceps to the face high is, then, never permissible to any but a thoroughly skilled operator, and even in such hands it should be reserved for a last resort. In posterior positions the forceps is *never* permissible, and it should be forbidden both from its inherent difficulties and because success in the passage of the brim can only result in the production of that very dangerous condition, a posterior position of the face within the excavation.

Management of Face Presentations, Low.—Chin Anterior.—When a face presentation has been allowed to pass the brim or has not been discovered until it is within the excavation, its progress should be watched with great care, and the utmost pains must be taken to maintain complete extension throughout the second stage. A constant watch over the processes of nature must be maintained, since any considerable delay is attended by great danger to the life of the child, from the likelihood that an interruption of its cerebral circulation may occur as a result of the extreme tension necessarily put upon the vessels of the neck or of their compression against the sides of the pelvis.

It follows from these dangers that even moderate delay furnishes a sufficient indication for the use of low forceps in face presentations. Complete extension, as has been said, is of the utmost importance, and, fortunately, may easily be maintained by pressure with the fingers upon the under surface of the lower jaw. Should interference become necessary, it is absolutely important that the forceps should be applied to the sides of the cranium, and with the tips so far posterior as to be entirely clear of the neck. In anterior positions, if this necessity be borne in mind, the application of forceps is easy, and the extraction of the child ordinarily presents no great difficulties; but it must not be forgotten that pressure upon the tissues of the neck by the tips of the blades must almost invariably result in loss of the child.

Chin Posterior.—As has been said, the face should never be allowed to enter the pelvis chin posterior. If this abnormality is not discovered until it has occurred, the patient should at once be etherized, the hand be introduced, and the possibility of raising the head above the brim should be tested. If this is possible without grave risk to the mother, it should at once be done, and the face dealt with according to the principles already outlined for the operative treatment of the face high (p. 463).

If elevation of the head proves impossible, the obstetrician should content himself with the maintenance of extreme extension by traction upon the chin in combination with a constant attempt to promote rotation by drawing the chin forward with the fingers. This process should be persisted in so long as there is, in his judgment, any possibility of rotation. When this prospect becomes hopeless, forceps may be applied and an attempt be made to extract the face as a persistently posterior chin presentation.

Any attempt at rotation by the forceps must be forbidden, both because of the grave danger of provoking extensive lacerations of the mother that necessarily attends this manœuvre, and because any slipping of the blades upon the child or any oblique application of the forceps would necessarily involve compression of the vessels of the fetal neck, and therefore the loss of the fetus. A straight forceps should be used if it is at hand. It should be applied carefully to the sides of the head and with the tips well anterior, so that the grasp of the blades may be wholly upon the cranial vault. The tractions should be directed slightly backward until the perineum is thoroughly upon the stretch, then forward and upward until the chin emerges, and then well downward, that the occiput may emerge under the arch and the head be born by flexion. Since lacerations of the pelvic floor are inevitable in this operation, and since every possible advantage must be taken, the perineum should be incised by deep lateral incisions as a preliminary measure.

This process has not yet been successful in the extraction of a living child; but since it has never, so far as known, been adopted while the child was in good condition, and as it has several times succeeded in extracting dead but uninjured children, it deserves a more extended trial whenever a child, in this position is still in fairly good condition. If the child's vitality is already seriously compromised, its chances of life are so small that the prospect of preserv-

ing the mother's soft tissues would, in the judgment of most obstetricians, justify the choice of craniotomy.*

3. BROW PRESENTATIONS.

Frequency.—As face cases have usually, if not invariably, passed through the stage of brow in the process of their conversion from a vertex presentation, temporary presentations of the brow must be at least as frequent as those of the face; but if only those brow presentations which remain such until altered by the obstetrician are included in the list, the frequency becomes less—probably not more than 1 in 1500 labors.

Relative Frequency of the Positions.—Brow O. L. A. and brow O. D. P. are almost equally frequent. The others are much less common.

Etiology.—Brow presentations are due to the same causes that produce presentations of the face, but it is of course a fact that if the process of extension is arrested in the stage of brow, it implies a greater obstacle to the progress of the head than where nature is able to develop a face presentation.

Diagnosis.—On *abdominal examination* the two ends of the head are found at about the same level, and the heart is usually heard over the back. On *vaginal examination* the small fontanelle is found at one end of the field, the large fontanelle in its centre, and the supraorbital ridges on the other side.

Prognosis.—Since at term and with a normal head the spontaneous delivery of an unchanged brow presentation is possible only after a degree of prolongation of labor that is disapproved by modern obstetrics, the prognosis of persistent brow presentations for both mother and child is that of the operation chosen. It should be remembered, however, that when nature changes the brow to a face the prognosis becomes that of a face presentation.

Mechanism and Management of Brow Presentations.

Mechanism of Presentations of the Brow.—*Anterior Position of the Brow*

(that is, brow O. D. P. and brow O. L. P.).—In the rare cases in which a presentation of the brow succeeds in entering the pelvis, this possibility is due to the fact that the moulding of the head has progressed until the occipito-mental diameter has become sufficiently small to pass the oblique at the brim, and this change is compensated for by a corresponding increase in the occipito-frontal diameter (Fig. 272). The increase in the length of this diameter necessarily



FIG. 272.—Configuration of the fetal head after its delivery as a brow presentation.

carries the forehead much deeper into the pelvis than any other part of the

* Since the above was written the great success of symphysiotomy has led most obstetricians to believe that a division of the symphysis should precede all applications of the forceps to a persistently posterior position of the face.

head, so that in anterior positions of the brow the projecting forehead engages in the anterior groove of the lateral pelvic wall as soon as the brim has been passed, and reaches its deeper part by the time the occiput escapes from the sacro-iliac notch and enters the shallow upper part of the posterior groove of the opposite pelvic wall.

If the conditions are so exceptionally favorable as to permit of the expulsion of an unchanged brow presentation, the forehead moves forward along the course of the anterior groove, while the occiput, being still in the shallow upper part of the posterior groove of the opposite side, moves back into the hollow of the sacrum; the root of the nose comes to the pubic arch, and the progress of the anterior portion of the head is then arrested, while the occiput travels down along the posterior wall of the pelvis and across the perineum. The nose and the chin then appear beneath the pubic arch, and the head in anterior positions of the brow is thus expelled by extension. External rotation, of course, carries the occiput to the side to which it was originally directed.

Posterior Positions of the Brow (that is, brow O. L. A. and brow O. D. A.).—Should an unchanged posterior position of the brow succeed in passing the brim, the forehead would enter the posterior groove and the occiput would lie against the shallow portion of the anterior groove. If the case went on to delivery, the rotation of the forehead along the posterior groove would be similar to that of the occiput in occipito-posterior positions of the vertex; but when the enormous difficulties incident to the expulsion of the brow under the most favorable circumstances are increased by the inherent difficulties always attached to rotation in posterior positions, the sum-total of the obstacle becomes so great that a delivery is almost unknown, and it may be laid down as a practical rule that posterior positions of the brow always become arrested.

Management of Brow Presentations: Management at the Brim.—

When a brow presentation is detected at the brim, we may deal with it by any one of the four following methods: the case may be left to the care of nature; the brow may be converted into a vertex by manual flexion; the brow may be changed into a face by manual extension; or the case may be delivered by immediate version. The choice between these methods of treatment depends primarily on the position, but in posterior positions of the brow—that is, when the occiput is anterior—the indications are considerably modified by the presence of excessive moulding of the presenting part.

Anterior Positions of the Brow.—The class of cases which should be left to the care of nature is extremely limited, and includes only those few cases of anterior positions of the brow which, when detected, are rapidly changing into anterior positions of the face, and in which the conditions of the case are such that, if the face becomes established, its progress is certain to be rapid and easy. Flexion of such a brow would produce a posterior position of the vertex, and there is then but little hope of a spontaneous delivery of the new presentation, since the marked tendency to extension which always characterizes the posterior positions of the vertex would almost certainly reproduce the

brow, while if an operative delivery is to be undertaken, version is the operation of election in posterior positions of the vertex. It follows that version is the operation of choice in anterior positions of the brow (see *Management of Face Presentations at the Brim*, p. 462).

All other anterior positions of the brow should be dealt with by immediate version as the operation of choice, the production of a vertex by manual flexion being ruled out for the following reasons:

In freeing a partially-engaged brow from the brim of the pelvis as a preliminary to version, it is essential that the first effort at raising the head should be directed against the forehead, since a preliminary flexion of the head replaces the long occipito-mental diameter by the shorter occipito-frontal diameter, and the subsequent elevation of the head therefore exposes the tissues of the mother to far less risk than would be involved in an attempt to force the extended occipito-mental diameter bodily upward. Moderate flexion is, moreover, an important element to success in the subsequent manipulations of the version, since its production minimizes the obstacle offered by the projecting sinciput.

When in anterior positions of the brow which promise a difficult delivery an attempt at version fails, a manual extension of the brow to an anterior position of the face, to be followed by forceps, is the only alternative to craniotomy, unless the condition of the child warrants a resort to one of the major cutting operations (see *The Use of Forceps to the Face at the Brim*, p. 464).

When the brow presents in a *posterior position*—that is, with the occiput anterior and with the head *unmoulded*—its treatment by manual flexion results in the production of an anterior position of the vertex, and a manual flexion is therefore in these cases the operation of choice. After the re-establishment of flexion the head should be held in position by the hands for a few pains; but, unless its engagement occurs promptly, it is usually best to resort to an immediate application of the forceps, since it may fairly be presumed that the conditions which originally led to the loss of flexion are still present, and will probably reproduce the extension if the case is left to itself. In this position of the brow a manual extension is contra-indicated, since it could only result in the production of a posterior variety of the face, which in itself is so dangerous that it demands an immediate version. If, therefore, in these cases a manual flexion is ruled out, version should again be selected as the operation of second choice.

When the brow presents in a *posterior position*—that is, with the occiput anterior and with the head already *much moulded*—the operation of manual restoration of the vertex must be ruled out in the interest of the child, for the following reasons: First, if a marked change of shape is apparent at the time the presentation is detected, the restoration of a vertex presentation by a manual flexion of the head presents great difficulty; moreover, the conditions are so much altered by the change in shape of the head that its re-extension into a brow would almost certainly occur as soon as the pains reappear or the forceps is applied. Second, a vertex delivery involves so extensive a re-

moulding of the head to its original shape as to expose the child to great risk of danger from cerebral hemorrhage; while the delivery of a much-moulded brow by version—that is, by the extraction of the after-coming head—results in but little change in shape, and is therefore much the safer for the child. Version is, then, the only operation which should be considered in these cases.

The operative treatment of brow presentations, high, may be summarized as follows: In anterior positions, version is the operation of choice. In the posterior positions of unmoulded brows a manual flexion to an anterior position of the vertex and a subsequent application of forceps to the head should be preferred; this failing, version should be the second choice.* In the posterior positions of much-moulded heads version should be selected.

A high application of forceps to the brow is ordinarily more dangerous to the mother than a craniotomy, and but little more hopeful for the child. The abdominal operations would be indicated only in the interests of the child, and would usually be contra-indicated by the fact that the vitality of the child is usually considerably lowered by the time the ordinary operations have become impossible.

Management of Brow Presentations after their Entrance into the Pelvis.—Since the brow never enters the pelvis until after an excessive moulding has been produced, and since the adaptation is then always so close that any alteration of the presentation is impossible, it is unnecessary to discuss in this connection any other problem than the delivery of the brow as such excessively moulded and closely adapted to the pelvic cavity.

If the *sinciput* is *anterior*, the forceps should be applied to the sides of the head with the concavity of its pelvic curve anterior, and the mechanism of the natural delivery of a persistent brow should be imitated. The tractions should be directed downward and backward until the root of the nose engages at the arch, and their direction should then gradually be moved forward and upward until the occiput sweeps forward over the perineum, then downward again to permit the emergence of the face; but the chance of extracting a living child in this way is so small, and the risk to the mother's tissues is so extremely great, that the application is never permissible unless the child is in fairly good condition. If its vitality is already seriously lessened, it is probably the best practice to deliver by craniotomy. Such cases are, fortunately, almost never seen during the life of the child, and perhaps never at term.

If the brow has entered the pelvis with the *sinciput posterior*, and the child is still alive, a very cautious attempt to promote rotation by the forceps might be justifiable; but success would be extremely unlikely, and a resort to craniotomy would almost certainly be necessary. This condition, however, is so extremely rare that it is almost unnecessary to refer to it.

* An extension to a face and a subsequent rotation of the chin to the front are occasionally possible, but this operation is always difficult, and should not be attempted by operators of small experience.

4. PELVIC PRESENTATIONS.

Pelvic presentations are commonly divided into breech, knee, and footling presentations; but knee and footling presentations are so similar in every respect to those of the whole breech that it is convenient to treat them as sub-variations.

Frequency.—Pelvic presentations occur in about 1 in 30 labors when miscarriages and premature labors are included. Among labors at term, however, their frequency falls to about 1 in 60 cases. Thus, Pinard found among 100,000 cases 3301 pelvic presentations, but on excluding the premature cases the proportion fell to 1 in 62. Among pelvic presentations about 60 per cent. are presentations of the breech.

Etiology.—Pelvic presentations are produced by the failure of the conditions which ordinarily ensure the existence of cephalic presentations (see p. 418). They are, then, especially frequent among premature and macerated children, when the liquor amnii is excessive and when the uterine and abdominal walls are very lax. They are the rule in hydrocephalus, and one out of every four twins is a breech child. In deformed pelvis, too, in which the head is unlikely to become fixed at the inlet during the last weeks of pregnancy, breech presentations become more frequent. S. D. A. and S. L. P.—that is, the two positions in which the long diameter of the breech occupies the first oblique diameter of the inlet—are much more common than S. L. A. and S. D. P. Knee and footling presentations are probably always secondary, and are due to an active movement of the fetal limbs.

Diagnosis.—On *abdominal examination* the head is found at the fundus and its absence is noted at the brim; the heart is heard above the umbilicus. On *vaginal examination* in presentations of the breech the presenting part is at first high and is reached with difficulty. The finger recognizes the vulva or the scrotum and penis, as the case may be, the anus, and the sacral spines. On rectal examination of the fetus the coccyx, the tuberosities of the ilia, and the pubic arch are easily recognizable. The position is best determined by the position of the coccyx as ascertained by a rectal examination. In knee and footling cases the prolapsed extremity is recognized by its anatomical characters (see p. 415).

Prognosis.—The prognosis for the mother in breech presentations is only altered from the normal by the frequency with which rapid extractions are necessary, and by the fact that in such extractions there is a greatly increased risk of laceration. The prognosis for the child is always poor, the mortality running as high as 10 per cent. in skilled hands. The prognosis for both patients is worse when the mother's soft parts are rigid—for example, in primiparæ.

Mechanism and Management of Breech Presentations.

Mechanism of Breech Presentations.—*Normal Mechanism.*—In breech presentations the first stage is ordinarily abnormally slow. If the membranes

are intact, the dilatation of the os is performed by them as in head presentations, and every care should be taken to preserve their integrity until the os is fully dilated. This precaution is of special importance in breech presentations, since, although the small and tapering breech is not ill-adapted to the dilatation of the os, the breech, when considered as a dilating wedge, labors under the disadvantage that its small size renders its passage through the cervix an inefficient preparation of the soft parts for the passage of the larger and harder head; extensive lacerations of the cervix are therefore frequent whenever the preparation of the cervix has been entrusted to the breech.

When the resistance of the cervix has been overcome, the comparatively small and soft breech naturally enters the pelvis easily, as the bitrochanteric diameter, the greatest diameter of the breech, is less than any of the diameters of the brim. The bitrochanteric diameter enters in one or the other oblique diameter, and is then crowded downward into the pelvis until the posterior hip impinges on the pelvic floor, when, under the forward shunt of this portion of the posterior wall of the pelvis, the breech as a whole bends forward by a lateral inflection of the trunk (Fig. 273). This movement engages the anterior hip in the deep portion of the anterior groove of that side of the pelvis to which it is directed, and as the anterior hip rotates forward the posterior hip slips back into the groove of the sacrum. The lateral inflection becomes well marked, the anterior buttock appears at the vulva, and as the trunk is driven more deeply into the pelvis by the uterine contractions the anterior hip becomes fixed at the pubic arch, and the posterior hip swings forward until the posterior buttock and trochanter appear successively from under the fourchette.

As the posterior half of the breech emerges the perineum retracts upward along the child's pelvis, and, all pressure being thus removed from the posterior surface of the breech, the inflection is released and the trunk of the child is permitted to straighten itself again, thus releasing the anterior hip from its position of pressure against the pubic arch; the whole trunk then moves downward through the pelvis, and only such moderate lateral inflection as is necessary to accommodate the trunk to the course of the pelvic bones still persists. When the legs remain, as they should, in their normal position of flexion, the escape of the knees from the vulva releases the lower extremities.

At about the time the umbilicus appears at the vulva the shoulders enter the brim, their transverse axis lying in the oblique diameter. If the arms remain in their normal position—that is, crossed over the breast—the anterior



FIG. 273.—Lateral inflection of the trunk during expulsion of the breech.

shoulder rotates to the arch and is delayed by fixation against its inner surface, while the posterior shoulder and elbow pass the vulva. The escape of the posterior shoulder so diminishes the size of that portion of the body occupying the outlet as to permit the anterior shoulder to escape from the arch and emerge from beneath it.

The pressure of the uterus upon the longer arm of the cephalic lever should, under normal conditions, preserve the flexion of the head. In this condition the chin and the face necessarily enter the pelvis first, the suboccipito-frontal and suboccipito-bregmatic diameters occupying one of the oblique diameters of the superior strait. Since, at the time the head engages at the superior strait, the shoulders have already rotated into a position in which the bis-acromial diameter occupies the antero-posterior diameter of the outlet, the head approaches the superior strait in a transverse diameter, but the recession of the posterior portion of the lateral wall of the pelvis at the brim, as it approaches the sacro-iliac notch, causes the face and the forehead, the first portion of the head entering the pelvis, to swing backward into a posterior position. The after-coming head thus normally enters in an occipito-anterior position.

As the head enters the excavation the sinciput is so much lower in the pelvis than the occipital end of the head that it swings along the course of the posterior groove until it slips into the median line upon the pelvic floor, the occiput which is still exposed to the smooth bony surface of the brim at the same time rotating to the median line in front. The face appears followed by the forehead at the vulva, the perineum retracts over the bregmatic region, and the head is born, still in a state of flexion.

Abnormal Mechanism of Breech Presentations.—The frequent occurrence of abnormalities in breech presentations is to be accounted for by the ease with which the legs, the arms, and the head may become extended by friction against the pelvic wall. The descent of the legs and the arms should normally be accomplished *pari passu* with that of the body through the transmission of the uterine force to their upper surfaces by the liquor amnii; but in a large proportion of cases the cervix has still sufficient resiliency to contract tightly upon the fetal trunk after the legs have passed the cervix. The upper surface of the legs is then cut off from the pressure of the liquor amnii, while their descent is still opposed by an undiminished friction against the pelvic walls; again, they may be detained by being themselves caught in the grasp of the cervix, while the body continues to descend; or, finally, they may have been placed in an extended position by the action of their intrinsic muscles. As a result, it not infrequently occurs that the legs become extended against the body during the descent of the breech. Under these circumstances it occasionally happens that the legs are sufficiently closely applied to the child to act as rigid splints to its trunk, thus causing arrest by preventing the lateral inflection necessary to the passage of the trunk. An arrest due to this cause usually necessitates a resort to operative interference.

The re-contraction of the cervix upon the body may also result in an extension of the arms upward during the descent of the shoulders, until they lie along

the sides of the head. The shoulders then enter the pelvis normally, but their further progress is arrested by the fact that, unless the child be small or the pelvis be unusually ample, the head and the arms form too bulky a mass to enter the pelvis together easily, and the interference of the obstetrician is again required. Even though the legs and the arms maintain their normal relations to the trunk, the passage of the head may be arrested by extension. Under normal circumstances the sinciput is driven into the pelvis, because the pressure of the liquor amnii upon the forehead is usually sufficient to overcome the resistance of the face against the pelvic walls, and there is nothing, therefore, to disturb the original relation of flexion of the head upon the chest; but if the attendant is injudicious enough to make traction, or if the already delivered portion of the trunk is unsupported, its weight, under the influence of gravity, is transmitted to the head through the occipito-atlantoid articulation, and a traction is thus initiated which is exerted solely against the occipital end of the head. The result is an abnormally rapid descent of the occiput. If this descent occurs before the head enters the superior strait, it may cause sufficient extension to result in the entrance of the occipito-mental or the occipito-frontal diameter into the superior strait, and thus produce an arrest of the head in this portion of the pelvis. If the influence of gravity only becomes active after the entrance of the forehead into the pelvis, no more than a partial extension is likely to result, but this partial extension brings the occiput into the deeper portion of the anterior groove of one lateral wall, while the sinciput rests in the posterior groove of the opposite wall. Rotation of the forehead forward is thus prevented, and there results a dead-lock which can only be broken up when a rapid descent of the forehead—that is, the restoration of flexion—is secured by operative influence.

Still another abnormality occasionally occurs. When the child is small or the pelvis is exceptionally ample—in other words, when the adaptation between the child and the pelvis is abnormally easy—the shoulders may enter the brim in the transverse diameter. If the back of the child is anterior, this produces no modification of the mechanism; the shoulders become oblique, and finally antero-posterior, during their passage through the lower part of the pelvis, the head enters with the sinciput posterior, and the birth goes on normally. If, however, the shoulders enter the superior strait transversely in a posterior position of the breech, the face and the forehead usually become engaged in the anterior portion of the pelvis before rotation of the shoulders can occur. If, under these circumstances, the flexion of the head is thoroughly well marked, the forehead passes along down the course of the anterior groove, the face appears under the arch while the neck retracts the perineum, and, if the pains are of the very best, the forehead may be urged down under the arch and the head be born in flexion.

The successful conduct of this form of mechanism by the forces of nature is, however, rare. It often happens that the projecting chin, the mouth, or the nose catches upon the upper border of the pubic bones. The sincipital end of the head is then delayed, extension results, the head jams across the brim by

the occipito-mental or the occipito-frontal diameter, and an absolute arrest usually follows. Delivery by the efforts of nature then almost never occurs, and is only possible when the adaptation is so easy that the uterus is able to drive the occiput through the brim, while the chin slips upward and forward over the horizontal ramus of the pubes in order to make room for it. If this happy release of the chin happens, complete extension follows, the occiput appears under the fourchette, and the head is born in extension. This movement of extension is, however, usually accomplished only by traction on the body or by the application of the forceps; even then it is likely to involve so much delay that the preservation of the life of the child is unlikely.

Management of Breech Presentations.—Nothing more thoroughly tests the skill and judgment of the obstetrician than his management of a breech presentation. Upon the one hand, it is of the first importance that he should remain inactive so long as the natural processes are progressing satisfactorily. Upon the other hand, he must be prompt to foresee the appearance of danger to the child, and to interfere as soon as this danger is manifest. He cannot be warned too strongly to avoid premature interference, since the use of traction instantly disarranges the delicate balance by which the normal attitude of the child is maintained. As before stated, the maintenance of flexion in natural breech labor is due to the facts that the legs, arms, and forehead are driven down by the action of the intra-uterine-fluid pressure upon their upper surfaces, and that this pressure is more than sufficient to overcome the friction of the pelvic walls against the lower surfaces of these parts; but when traction is made upon the breech, the additional force thus supplied is distributed to the members only through the knees, the shoulders, and the occipito-atlantoid articulation respectively, while the very fact of its application—that is, the promotion of a more rapid descent—increases the force of friction exerted against the feet, the hands, and the forehead. Traction is then almost invariably followed by extension of the legs, the arms, and the head, with all its inherent difficulties.

When, however, interference is demanded, speed in extracting the arms and head is essential. After the scapulæ appear five minutes is an average time, within which the mouth should be brought to the vulva.

He who interferes in a breech delivery should feel that unless unusual good fortune attends his efforts he is likely to be confronted by the necessity of a manual delivery of each and every portion of the child's anatomy as these portions successively approach the pelvis. Even in the most skilled hands this process is attended by much more danger to the child than is involved in a natural delivery.

Since natural delivery is ordinarily possible only when complete flexion is maintained, since a single traction is likely to produce extension, and since, when extension has once occurred, delivery is ordinarily possible only by the immediate adoption and subsequent prosecution of an operative extraction, it becomes evident how important it is that the obstetrician should remain absolutely inactive unless there arise circumstances which show him that nature is

likely to fail—that is, that the best chances for the child have been lost, and that the second best must be taken; for if it be true, upon the one hand, that a prompt natural delivery is safer for both mother and child than the best operative interference, it is equally true, upon the other hand, that when nature fails in promptness the only hope for the child and the best prospect for the mother is to be secured by the immediate performance of an operative delivery.

Management of Normal Breech Labor.—In breech labor the obstetrician's duty, so long as progress is normally rapid, is reduced to the following details:

It is wise never to conduct a breech labor without one skilled assistant, if such a person can be obtained. This assistant should give the ether if this is required, and should be ready to apply suprapubic pressure to the head if a rapid extraction becomes necessary. When delivery is imminent the woman should be placed in the lithotomy position, since there is never any certainty that interference may not become necessary at any moment. It is also well to put the patient slightly under the influence of ether as soon as the delivery is thought to be near at hand, since, if interference is indicated, it is rendered greatly easier by anesthesia, and because a partial anesthesia can be raised to the surgical degree with much less loss of time than is necessary to produce unconsciousness in a totally unetherized patient.

From the time the breech enters the pelvis the fetal heart should carefully be watched, since there is always danger of compression of the cord, and for this reason any irregularity of the fetal heart is sufficient cause for interference. As soon as the cord can be reached its pulsations will keep the obstetrician informed of the condition of the child.

As soon as the buttocks emerge from the vulva they should be wrapped in a warm sterilized cloth;* the attendant should do his utmost to relieve the perineum from undue strain by pressing the hips and the pelvis of the child into close contact with the arch; and even after the delivery of the hips he should continue to support the breech in an elevated position for the same reason. When the knees appear he should reduce the bulk of the presenting part by flexing out the legs. As soon as the umbilicus is within reach of the finger he should gently draw down a loop of the cord, to avoid the danger of undue tension upon the cord or upon the umbilicus during the subsequent descent of the body. The hips and the body should still be held constantly forward toward the mother's abdomen, in the curve of Carus, in order that the rotation and expulsion of the head may not be interfered with by the weight of the body; but no traction should be made during this process. As the elbows appear the forearms should be drawn out, and if the fetal body is sufficiently elevated the head should follow without delay.†

* *Rapid Extraction of the Breech when Arrested High.*—When a breech is arrested at the superior strait until the signs of exhaustion of one or the other

* Warm in order to lessen the danger of a premature respiration, sterile on account of its contact with the vulva.

† For the procedure of extracting the head and arms low, see page 480.

patient appear, or when a rapid delivery becomes necessary by reason of some condition which threatens the life of mother or child, five methods of securing descent are applicable: Traction may be made upon the anterior groin with the *finger*, the *fillet*, or the *blunt hook*; *forceps* may be applied to the breech; or the hand may be inserted into the uterus, and be made to *bring down a leg* for use as a handle by which to make traction.

Of these methods, the use of finger in the groin is always preferable when its employment is possible, but in high arrest of the breech the finger seldom has sufficient power to secure descent; and if the breech is but slightly engaged in the brim at the time interference becomes necessary, the introduction of the hand to bring down a leg is ordinarily the method which should be chosen when the finger in the groin fails. If the breech is already so far engaged as to render this manœuvre difficult or dangerous, the cautious employment of the blunt hook or the fillet is permissible. An operator of practised skill may succeed by the forceps, but the application of this instrument to the breech at the superior strait is not to be recommended to beginners.

The Use of the Finger.—In applying this method the half hand should be passed into the vagina, the forefinger be hooked into the groin in any manner



FIG. 274.—Proper (A) and improper (B) directions of traction upon the thigh.*

convenient to the operator, and traction be made downward and backward in the axis of the superior strait. Care should be taken to direct the line of traction rather toward that side of the pelvis to which the back of the child is directed, in order to lessen the danger of snapping the femur (Fig. 274).

The Blunt Hook.—Both the fillet and the blunt hook can usually be applied to the groin, without special difficulty, in any portion of the pelvis, and both furnish fairly effective means of traction; both instruments, however,

labor under the disadvantage of subjecting the tissues of the child to great risk of injury, the blunt hook, when skilfully used, being perhaps the less dangerous. The hook should be passed, under the guidance of the finger, between the anterior hip of the child and the pubic bones until it can be so rotated that its point passes between the child's thigh and abdomen. The finger should then be passed between the thighs and be brought into contact with the point of the hook, which should then be settled downward by gentle traction until its curve fits snugly into the flexure of the groin. The shank of the hook should then be grasped by the hand to which the finger belongs (Fig. 275), and traction should be made with the other hand, the finger lying in contact with the

* Though represented with the fillet, this Figure illustrates equally the manner of employing the fillet, the blunt hook, or the finger.

point of the hook throughout the extraction, in order to protect the soft parts from injury as far as possible. The line of traction should be directed toward the side on which the sacrum lies, in order to avoid fracture of the thigh.



FIG. 275.—Method of grasping the blunt hook.

The Fillet.—The fillet may be made of a piece of broad tape, preferably linen on account of its greater strength, or of a wide strip torn from a silk handkerchief; the best fillet known, however, is that made by passing a stout cord through a piece of rubber tubing about three-eighths of an inch in diameter. The fillet may occasionally be passed through the groin by the unaided fingers, but in high arrest it is seldom possible to succeed in adjusting it by this method. Several instruments have been devised for the special purpose of placing the fillet, but their place can be filled equally well by a piece of string and a large English webbing catheter. The disinfected catheter should be threaded with a double loop of disinfected string or of narrow bobbin, and with its stylette, should then be bent to the shape of the blunt hook (Fig. 276). The catheter should be passed into the groin in the manner directed for the use of the blunt hook, and the finger should draw down the projecting loop of string until the end of the fillet can be passed through it, when, by the removal of the catheter, the fillet is placed in position in the groin. The same precaution as to the direction of the line of traction must be observed with the fillet as that recommended for the blunt hook and the finger.



FIG. 276.—Use of the catheter as a porte-fillet.

The Use of Forceps.—If the forceps is used in high arrest of the breech, its application is similar to that which is to be described under low arrest (p. 478) although it is much more difficult.

The Extraction of a Leg.—In the introduction of the hand into the uterus to bring down a leg, the breech should be pressed back gently through the brim before any attempt is made to pass the hand. The utmost gentleness should be observed throughout this manœuvre, and undue tension on the utero-vaginal attachments should be avoided by a careful maintenance of counter-

pressure against the fundus with the other hand. The operator should always be careful to ascertain the position of the cord, to avoid the production of an unnecessary prolapse. If the foot is within reach, it should be seized and gently drawn out from the os. He should seize the anterior leg whenever that is accessible, as the line of traction on the anterior leg can be kept nearly in the axis of the inlet, while a pull on the rear leg brings the anterior buttock to a sitting position on the brim, and the traction in a line running from the child's hip, located near the mother's promontory through the vulva. If the legs are extended across the chest, two fingers should be placed along the crest of the tibia, and be used to so flex the leg that the foot passes down the median line of the child's abdomen until it reaches a position in which it can be seized and withdrawn.

When the foot appears at the vulva, the leg should be wrapped in a towel which has been dipped in a warm solution of corrosive sublimate, and traction should be made upon it in a line which should at first be directed as far backward as the perineum allows, in order to pull, so far as possible, in the axis of the superior strait. As the breech descends the line of traction should swing forward, until, when the hips clear the vulva, it is directed nearly vertically upward, the woman being in the lithotomy position. As soon as the knee is well outside the vulva the grasp should be shifted to the thigh, as any prolonged traction on the lower leg is apt to overstrain the ligaments of the knee-joint. If there is any difficulty in bringing the breech to the vulva, its delivery may be assisted by hooking the forefinger into the other groin as soon as it is within reach; as the breech distends the perineum it should be drawn well forward, and every effort should be made to prevent a laceration precisely as is done in the delivery of the fore-coming head.

When the second knee appears at the vulva, it should be drawn outward along the side of the child and toward its back, until the fingers can reach the leg and release the foot by flexion of the leg upon the thigh; but all pressure upon the shaft of the femur must carefully be avoided, since fracture of the femur during this process is always easy. Care should be taken to bend the knee only in the natural direction.

Rapid Extraction of the Breech when Arrested Low.—Low arrest of the breech can usually be overcome by the use of the *finger* in the groin, which method should always be the first tried. If this method fails, the use of the *fillet*, or, better, the *blunt hook*, is decidedly less dangerous to the child in low than in high arrest, the method of applying them being exactly the same; the *forceps* is here, however, easy and is almost invariably efficient; moreover, if due care is exercised, this instrument is far less likely to injure the child than is the blunt hook.

Application of the Forceps to the Breech Low.—If the breech lies in an antero-posterior or oblique position, the tip of one blade of the forceps should lie against the upper sacral vertebræ, while that of its fellow should be pressed into the flexor surface of the most easily accessible thigh (Fig. 277). If the position of the hips is transverse, each tip of the forceps should

impinge upon a femur just above or beyond the trochanter, which then furnishes a firm hold for the blades (Fig. 278).

In making the application the forceps should be placed in an approximately correct position upon the breech, locked, and held lightly in this position. A hand should then be passed into the vagina until the finger-tips can touch the exact spots at which the tips of the blades should lie; an accurate adjustment is then easily attained by direct movements of the tips of the blades with the internal fingers. The small size of the tapering breech, in comparison

with the diameters of any pelvis through which a living child can be extracted, renders it easy to obtain an accuracy in the adjustment of the forceps that is impossible of attainment when the forceps is used upon the head. It is this fact which renders the forceps valuable in this connection, since the avoidance of injury to the child and the attainment of a secure grasp of the breech are to be effected only by the adjustment of the tips to exactly the points to which they were directed, and the utmost care must be observed in verifying the position of the forceps before any traction is made. When the operator is sure that the instrument is satisfactorily in position, the handles should be grasped

sufficiently tight to ensure a firm pressure, which should then be maintained without intermission until after the delivery of the child.

The ordinary forceps is better adapted to this application than any special forms which have yet been devised. When the instrument is used upon the high breech the advantages of axis-traction are perhaps more fully apparent than in any other obstetric operation.

Rapid Extraction of the Trunk.—As soon as the legs and the pelvis of the child have cleared the vulva, they should be grasped (through a warm aseptic towel) in the manner shown in Figure 279, in which each thigh is grasped by



FIG. 277.—Forceps applied to an oblique position of the breech.



FIG. 278.—Forceps applied to a transverse position of the breech.

the fingers of one hand, the thumbs of the operator lying along the sacrum; this grasp should be maintained throughout the extraction, no other grasp



FIG. 279.—Method of grasping the thighs during the extraction of the breech.

being so secure, and any pressure upon the crests of the ilium or upon the abdomen of the child being dangerous to its bones and abdominal viscera. The line of traction should be directed as far backward as the perineum allows, in order to facilitate the passage of the shoulders through the superior strait, and the back of the child should be kept steadily directed upward—that is, toward the anterior portion of the mother's pelvis—to secure an anterior position of the occiput for the after-coming head. When the umbilicus appears at the vulva a loop of the cord should be drawn downward, as is done during the normal delivery of the breech.

Rapid Extraction of the After-coming Head and Arms.—If, by any chance, either arm remains flexed upon the in-

fant's chest, it may easily be drawn out when the elbow appears at the vulva; but in the great majority of cases both arms will be extended beside the head, and their extraction is then more difficult. The method that should be chosen for their release must depend upon the point of the pelvis at which the shoulders become arrested.

Low Arrest of the Arms and the Head.—In easy extractions it is very often possible to bring the shoulders into sight outside the vulva by simple traction upon the thighs. In such cases it is frequently possible to extract the after-coming head and arms by the very easy and simple manœuvre known as *Deventer's method*. In this procedure the body of the child is dropped downward as soon as the points of the shoulders are in sight; the feet are grasped with one hand, the fingers of the other hand being pressed upon the upper surface of the shoulders, and the child is drawn vertically downward toward the floor, the mother being in the lithotomy position. Under this traction the occiput appears at the vulva, and the forehead and face follow coincidentally with the arms. The mechanism by which this somewhat surprising delivery is accomplished is as follows: The method is applicable only when the pelvic space permits the head and the arms to enter the brim together, and both are then contained in the excavation when the shoulders are at the vulva. The arms are then in contact with the elastic sacro-sciatic ligaments, which stretch before them and permit them to lie by the side of the head. The chin is arrested by the pelvic floor; the head extends, and thus brings the occiput to the vulva. The head is then delivered in extension, and the arms follow

(Fig. 280). The original advocates of this method claimed that it rarely if ever tears the perineum, and the writer's experience with it certainly supports this claim.

When the conditions permit the head and the arms to enter the pelvis together—that is, when the shoulders can be brought to the vulva by traction upon the thighs—Deventer's method, though not the most powerful, is certainly by far the most rapid and easy of all the manoeuvres for the release of the head and the arms, and it should always be given a trial. It is necessarily inapplicable when the head and the arms are arrested at the superior strait. Traction then only increases the difficulty.

If the shoulders appear at the vulva, but Deventer's method fails, the method known as *combined traction on the face and the shoulders* should be tried. Two fingers should be passed along the upper surface of the most easily accessible arm until their tips rest in the bend of the child's elbow. The elbow should then be urged backward and toward the median line by the fingers, and be swept across the child's face to the vulva, at which the elbow, forearm, and hand appear in the order named. This process should then be repeated with the other arm. Pressure upon the shaft of the humerus should carefully be avoided, since it is certain to snap the bone. The child is then laid astride of one of the operator's forearms, and the hand belonging to this forearm is passed into the vagina until its first and second fingers lie upon the canine fossae of the child. The other hand is hooked over the shoulders, the neck being between its first and second fingers, with the finger-tips upon the supraclavicular region (Fig. 281). The hand that is hooked about the shoulders is then used to make traction upon the child, while the internal hand exerts itself to preserve the flexion of the head. The direction of the first tractions should be in the line of the axis of that part of the pelvis in which the child lies, and as the head emerges the line of traction should sweep forward in the curve of Carus until, at the end of the extraction, the body of the child rests upon the other forearm and along the abdomen of the mother (Fig. 282). When the mouth appears at the vulva

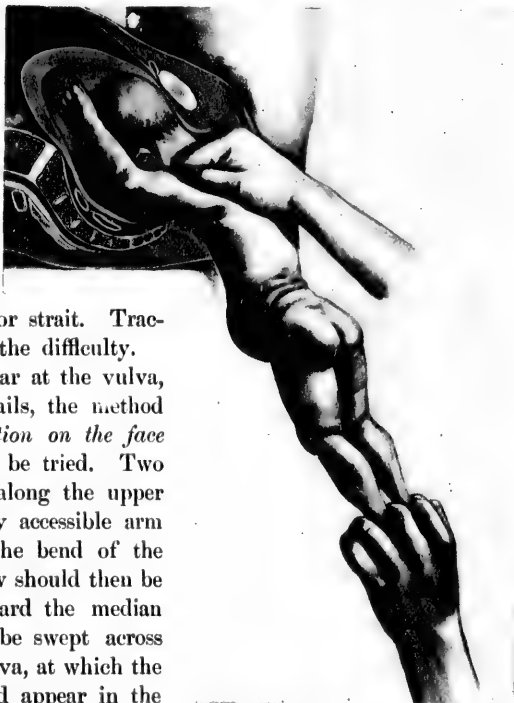


FIG. 280.—Deventer's method of extraction of the after-coming head and arms.

and the mouth and pharynx have been cleared out, all hurry ceases, and the

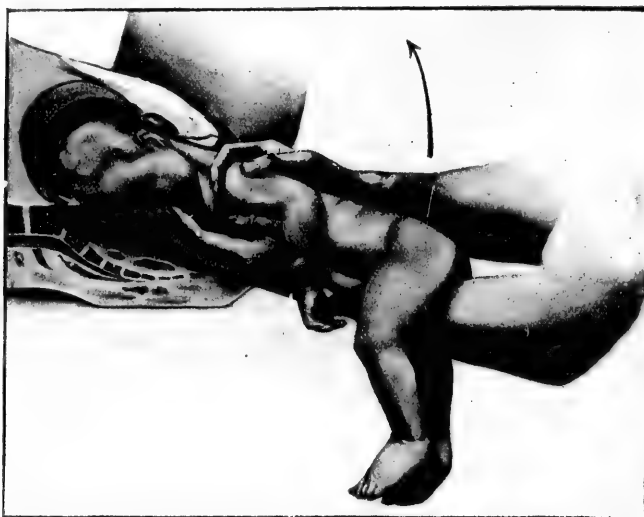


FIG. 281.—Delivery of the after-coming head by combined traction on the head and shoulders.

operator's efforts should be directed to the preservation of the perineum. But



FIG. 282.—Position of the child immediately after the escape of the after-coming head from the vulva.

little traction should now be used, and the hand that was applied to the face should be used to shell out the head by pressure on the forehead through the perineum, or, if necessary, by passing two fingers into the rectum.

High Arrest of the Arms and Head.—When the adaptation between the head and the pelvis is not sufficiently easy to permit the simultaneous entrance of the head and the arms into the pelvis, the arrest of the shoulders at the superior strait may be known by the fact that the child ceases to make progress, under tractions of ordinary strength, at about the time when the tips of the scapulae appear at the vulva. At this

point of the extraction it is therefore important to watch for a marked increase of resistance, and when this is observed the tractions should immediately be intermitted, since their continuance only serves to lock the head and the arms securely in the brim, thus rendering the subsequent manœuvres for their release more difficult.

The body of the child, in such an event, should be pressed slightly upward, and be rotated until the back is directed to one or the other side of the mother's pelvis. The hips should then be elevated gently toward the mother's abdomen and toward the side to which the back of the child is directed, moderate traction being exerted upon them at the same time. The object of this manœuvre is twofold: first, that space may be afforded for the passage of the hand into the vulva along the abdomen of the child; secondly, that the posterior shoulder, which is usually the most accessible, may be brought as deeply into the pelvis as possible.

The hand of the operator that naturally faces the abdomen of the child should then be passed rapidly into the vulva, with its palm flat against the abdomen and chest, until two fingers can be passed up along the arm of the child and their tips placed in position in the bend of the elbow. No pressure upon the arm should be made until this position is reached, but when it is attained the elbow should be drawn down across the child's face until the forearm and hand are within easy reach and can be brought to the vulva.

If the hand passed along the abdomen fails to reach the elbow, the latter may sometimes be found by seizing the feet in that hand and drawing them gently upward and to the opposite side, so that the hand which before held the feet can be passed along the back of the child close under the pubic arch to the back of the posterior shoulder, and thence along the arm to the elbow, which, however, must, as before, be brought downward across the child's face.

The hips of the child should then be swept downward and traction be made upon the thighs, in the hope that the pelvic space may permit the entrance of the head with the remaining arm; if this does not occur, the body of the child should again be pressed backward into the pelvis, and the child be so rotated that the arm which was anterior becomes posterior, when it should be released by the same method that was used in the extraction of the first arm. During this rotation the back of the child should sweep across the front of the mother's pelvis. This rotation may be effected either by grasping and turning the thorax with both hands or by drawing the already extracted arm forward along the side of the pelvis, between the labium and the back of the child.

In rotating the child it must always be remembered that the articulations of the neck are so arranged that if the point of the chin be carried beyond the point of the shoulder a dislocation of the atlas upon the axis is the result. For this reason the thorax should be pushed strongly upward whenever an attempt at rotation is made, in order to free the head from the superior strait; and the hands of the assistant should watch the head from above, that he may warn the operator if it fails to follow the shoulders. In the extraction of the head from the superior strait the method of combined traction upon face and

shoulders is usually the best, but it should then be reinforced by suprapubic pressure applied in the axis of the brim by the hands of an assistant.

Difficult Extraction of the Head and the Arms.—Arrest of an Arm behind the Occiput.—It sometimes happens that the head rotates with the shoulders, but the arm is detained behind the pubes by friction against its walls. In such a case the arm crosses the nape of the neck and, if traction is made, becomes jammed between the occiput and the symphysis. If this accident is discovered before traction has been made, prompt rotation in the reverse direction may unlock the arm, and in this case this reversed rotation should be continued until the arm becomes posterior—that is, through 180° ; but unless the first attempt unlocks the jam, the child will probably be lost, and it is then, perhaps, best to make direct traction upon the arm at the risk of fracturing the humerus, after forewarning those present that this must be the result, and that it is done in the interests of the child.

Closure of a Constriction-ring, or of an Imperfectly dilated Os, about the Neck.—The stricture of the canal formed by either of these conditions may embarrass the release of the arms, but it does not otherwise affect the above-described manœuvre, except that any abrupt or too forcible movements of the hand while within the uterus are even more dangerous in these cases than in others. The extraction of the head from the constricting band is, however, often a matter of great difficulty. Any attempt to overcome this obstruction by force exposes the mother to the most imminent danger of rupture of the uterus; and though steady traction upon the mouth and the shoulders should be given a fair trial, and may effect dilatation in time to save the child, it is in these cases that the application of forceps to the after-coming head is most often indicated. There can be no doubt of the truth of Lusk's observation, that "the forceps will sometimes bring the head rapidly through the cervix when traction upon the feet only serves to drag the uterus to the vulva." Care should be taken, however, that this rapidity be not so great as in itself to cause a serious laceration.

Arrest of the Head at the Superior Strait by reason of an Unusual Size of the Head.—Most German and American obstetricians believe that the use of combined traction upon the face and the shoulders is the best method to adopt in arrest of the after-coming head at any point in the pelvis, and it should certainly be the first method tried in any given case; but as cases frequently occur in which the head can be delivered with far greater ease by a rapid alternation between two or more methods than by the continued use of any one alone, it is for this reason, if for no other, well to be familiar with all the methods which have been found of value.

The Prague Method.—This manœuvre is often of service in effecting the engagement of the head and its initial descent into the superior strait. This is especially true in certain forms of contracted pelvis and with operators whose muscular strength is inadequate to the really severe strain which is sometimes imposed upon the internal hand in the use of the combined method at the brim, but it is usually inferior to the combined method after the greatest diam-

eter of the head has passed the superior strait. Like all methods of manual extraction, it is greatly increased in value by the application of proper suprapubic pressure by an assistant.

In executing the Prague method the feet are seized by one hand and the body is drawn as far downward as the perineum allows; the other hand is



FIG. 283.—Delivery of the after-coming head by flexion through seizure of lower jaw, and extrusion by means of pressure in axis of brim.

then hooked over the shoulders, and traction is made by both hands simultaneously (Fig. 284). As the head enters the excavation the body is swung rapidly upward, and the remainder of the delivery is accomplished by upward



FIG. 284.—Prague method of extracting the after-coming head, superior strait.

traction on the feet, while the hand upon the neck promotes flexion by retarding the descent of the occiput (Fig. 285). The chief disadvantage of the Prague method lies in the fact that all the force exerted by the operator is expended upon the child's neck, and that the amount of force that can safely be applied is therefore less than in the combined method.

Arrest from Extension of the Head.—This condition is rare unless in improperly conducted extractions, but if, by any clumsiness on the part of the operator, the abdomen of the child has been directed to the front during the liberation of the arms, and the chin is therefore arrested at the symphysis, the Prague method should be used throughout. In this case the direction of the first traction should be nearly horizontal (Fig. 286), and as the occiput descends the body of the child should be raised until, when the head emerges from the vulva, the line of traction is nearly parallel with the mother's abdomen.*



FIG. 285.—Prague method of extracting the after-coming head, inferior strait.

fails to deliver by manual extraction; but as such cases do occasionally occur, the forceps should always be at hand before the delivery is attempted. If

Forceps to the After-coming Head at the Superior Strait.—The use of the forceps is generally believed to be the most powerful and certain means of overcoming difficult cases of high arrest of the after-coming head. This operation is, however, often difficult, and the time occupied in the application of the forceps may be of vital importance to the child. Moreover, there are but few cases in which a skilled operator, aided by efficient suprapubic pressure,



FIG. 286.—Extraction of after-coming head, chin arrested at symphysis.

forceps be used, the body should be raised to a nearly vertical position, and the

* If forceps is necessary, the instrument should be applied under the child's body, and should extract by the same mechanism.

forceps should be passed into place upon the sides of the head, beneath the abdomen of the child. An axis-traction model should be preferred.

Arrest of the Head at the Inferior Strait or on the Perineum.—Cases in which manual extraction by the combined method fails to overcome a low arrest are extremely rare, but if forceps be required the application and extraction are always easy.

Arrest of the Head due to Contraction of the Pelvis.—In the ordinary form of contraction the arrest is always at the brim, and after the head has passed the superior strait the subsequent delivery is easy.

A breech presentation should never be allowed to persist as such in a *justo-minor pelvis*, but if it has not been corrected the inevitable arrest of the head at the superior strait should be met by extreme flexion and by the application of forceps, followed by craniotomy if not promptly successful.

In all *flat pelvises*, and in flat pelvises only, the head enters the superior strait in the transverse diameter, and the passage of the strait is most easily effected in a somewhat extended position, in which the biparietal diameter is received by one of the sacro-iliac notches, while the lesser bimastoid diameter is opposed to the contracted conjugate: if, then, the hand, when it is passed into the vagina for combined traction, finds the head transverse, it should allow extension to go on until the face begins to approach the side wall of the pelvis or until the greatest diameter of the head has passed the superior strait; when this has occurred flexion should promptly be restored, and rotation and delivery will then rapidly follow.

In *simple flat pelvises* the application of forceps to the after-coming head is rarely successful after manual extraction has failed, but in pelvises of the *generally-contracted flat* type, if the transverse diameter is markedly diminished, the mechanism approaches that of a normal or *justo-minor pelvis*, and if the breech presents and efforts at manual extraction of the head fail, the application of the forceps may be tried.

5. FOOTLING PRESENTATIONS.

Mechanism and Management.—The mechanism of footling presentations is in no way different from that of presentations of the whole breech. The treatment varies only in that in a rapid extraction there can be no question as to the choice of operation.

6. TRANSVERSE PRESENTATIONS.

Under transverse presentations are included presentations of any portion of the trunk; but as all transverse presentations soon change to presentations of the shoulder, it is only necessary to speak of the latter.

Frequency.—Transverse presentations occur in from 1 in 150 to 1 in 300 of all cases of labor. Thus, Spiegelberg made the proportion 1 in 180; Churchill, 1 in 252; and the Guy's Hospital Reports, 1 in 297 (or .32 per cent. out of 22,980 cases of labor). The positions are of but little importance.

Etiology.—Transverse and breech presentations are produced by the same

causes (see p. 470), but in transverse presentations the influence of pelvic deformities is somewhat more important, since, if the head cannot enter the brim, it may slip to one side and permit the shoulder to enter even after labor is well under way.

Diagnosis.—On *abdominal examination* the longest diameter of the uterus is transverse; the head is found in one flank, and the breech in the other. On *vaginal examination* the finger may be able to recognize the clavicle and the spinous process of the scapula, and to ascertain that there is but one limb attached to the presenting part, but the vaginal diagnosis is apt to be obscure unless an arm is prolapsed.

Prognosis.—As the termination of a transverse presentation by natural labor is extremely rare, the prognosis for both mother and child is necessarily that of the operation undertaken. When the abnormality is detected and treated early, the prognosis for both patients should be fairly good, but it becomes worse in proportion to the length of time during which the case is allowed to go on untreated.

Mechanism and Management of Transverse Presentations.

Mechanism of Transverse Presentations.—Since natural delivery so rarely occurs in transverse presentations, the later stages of the mechanism by which it is effected are of small practical importance; but, notwithstanding the rarity of its completion, its earlier stages are rendered not unimportant by the fact that success in the delivery of impacted shoulders rests upon a thorough comprehension of the processes by which the impaction was effected, this being, in fact, the first stage of the mechanism of natural delivery in transverse presentations. The process is commonly known as the "spontaneous evolution of the fetus." Any part of the trunk may present at the beginning of labor; but as the fetus is crowded down into the brim, the shoulder inevitably enters deepest in persistent transverse presentations, and, since the shoulder always becomes anterior early in labor, it is only necessary to describe the anterior form.

In the anterior form the supraclavicular region corresponds, at the time of the entrance of the shoulder, with the anterior end of one oblique diameter at the brim, the lower portion of the thorax lying at the posterior end of the same oblique diameter. The full width of the shoulder enters the pelvis, and this portion of the child is then fixed in position by contact of the neck with the horizontal ramus of the pubes. Under the influence of the driving power of the uterus above, the lower portion of the thorax is forced more and more deeply into the posterior half of the pelvis by a lateral inflection of the body of the child upon itself. The trunk then dips into the excavation, the true ribs, false ribs, abdomen, and pelvis of the fetus entering in the order named (Fig. 287). If the child is sufficiently flexible and if the uterus is sufficiently powerful to complete the delivery, this process of lateral inflection of the trunk goes on until the pelvis of the child appears at the vulva, and with its expulsion the case is converted by spontaneous evolution into a presentation, or

rather an expulsion, of the breech, in which, however, one shoulder is already within the pelvis and one arm is already delivered.

A second and very much more rare form of delivery in persistent transverse presentations is seen only with immature fetuses, and it can seldom occur unless maceration is far advanced. In it the prolapsed shoulder is driven forward through the pelvis, the head of the child being crowded into the pelvis with the body (Fig. 288). The shoulder is the leading point, and it should

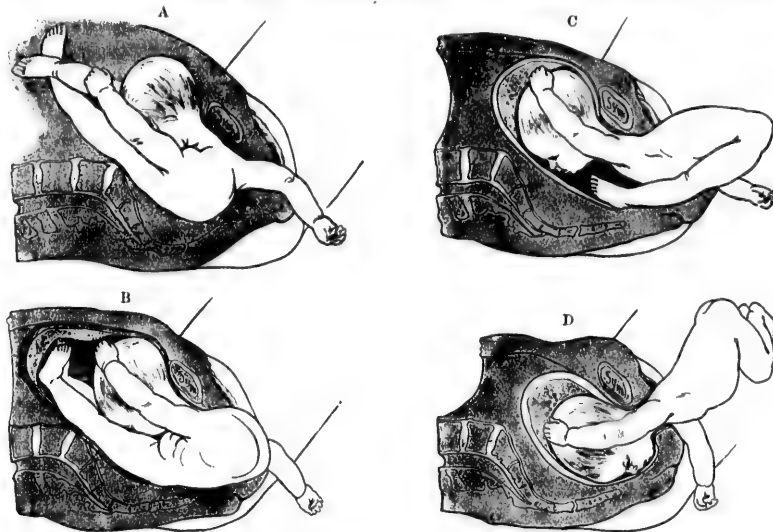


FIG. 287.—Spontaneous evolution, first form of mechanism.

rotate to the arch, but when this process is possible the body is always so small and soft that the mechanism is usually but little marked.

Management of Transverse Presentations.—The prognosis of spontaneous evolution is so bad for both child and mother that transverse presentations should never be left to nature, and the question of the treatment is simply the question of the choice of the operation to be adopted. Three operations are applicable to the treatment of transverse presentations in its various stages—the several varieties of *version*, *decapitation*, and *exenteration*, the choice between them depending upon the stage of labor at which the presentation is detected.

Version.—If the presentation is detected before any portion of the trunk is deeply engaged, and while the membranes are still unruptured, one or the other of the *external versions* should be chosen. If the abdomen or the hip presents, pelvic version will usually be the easiest, and for this reason should generally be preferred; if the conditions are such as to render cephalic version easy and if the pelvis is normal, cephalic version should be performed.

If the shoulder presents, cephalic version should be chosen, except in a flat pelvis, where the shape of the inlet makes a breech presentation the presenta-

tion of choice. In such cases an external pelvic version would naturally be chosen. If, at the time an operation is undertaken, the shoulder has already entered the pelvis, but the conditions of the case are still such as to permit of version, a *bipolar, cephalic, or pelvic version* should be performed.

If, at the time when interference is decided upon, the membranes are already ruptured, and especially if the shoulder is already well crowded into the pelvis, the external and bipolar methods will usually be impossible, and internal podalic version must be chosen.

Internal Podalic Version in Transverse Presentations.—This operation differs from internal version in head presentations only in the choice and method of introducing the hand, in the

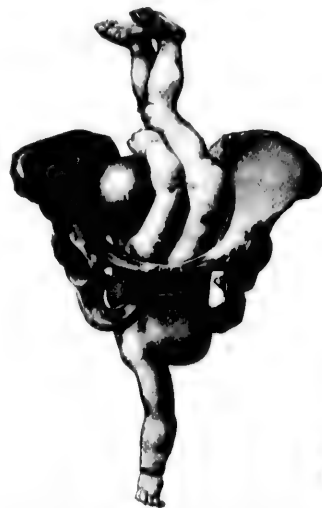


FIG. 288.—Spontaneous evolution, second and rare form of mechanism, known as birth with double body (one-sixth natural size, redrawn from Küstner).



FIG. 289.—Frozen section of shoulder presentation (Chiara): the distortion and the elongation of the neck are noteworthy.

frequent occurrence of a prolapsed arm, and in the method of raising an impacted shoulder.

In raising the shoulder it is necessary to remember the mechanism of the method by which nature deals with a neglected transverse presentation—that of spontaneous evolution. In this process, as has been said, the trunk enters the pelvis at the brim in an oblique diameter, but as it is forced farther down the shoulder rotates to the front and becomes fixed there, while the thorax and the abdomen are crowded into the posterior portion of the pelvis by flexion upon themselves (Fig. 287). Now, so long as the position is still oblique, and if flexion of the trunk has not begun, the presenting part may easily be raised by pressure upon the shoulder in the axis of the superior strait; but so soon as the shoulder has rotated to the front and the thorax has entered the pelvis, it is essential that the process of relieving the impaction should begin by the return of the part which entered last—that is, of that portion of the thorax and the abdomen still lying opposite the sacro-iliac synchondrosis. No pressure must be exerted upon the shoulder itself until the trunk again occupies an oblique position. It will be seen that the process of unlocking the impaction is by a direct reversal of the mechanism of spon-

taneous evolution. Of course, during this whole process the most careful counter-pressure must be maintained at the fundus.

In simple cases a prolapsed arm may be used as a convenient handle by which to push up the shoulder, and in all cases it is well to begin the opera-



FIG. 290.—Direct method of seizing a foot in version for transverse presentations.



FIG. 291.—Direct method of seizing a foot in version for transverse presentations.

tion by noosing a fillet around the prolapsed wrist. This fillet answers a double purpose: First, it may be used to draw the arm out of the way of the operating hand; second, during the process of extraction slight tractions on the fillet will prevent the extension of that arm, thus greatly facilitating the delivery; but care must be taken to remove the noose as soon as possible, for cases are on record in which sloughing of a member has followed the too prolonged or violent use of a fillet.

In the search for a foot two methods may be used: The hand that corresponds with the position—that is, left position, left hand—may be passed along the back and over the buttocks to the thigh and leg (Fig. 292), or the hand may be passed across the abdomen and directly to the feet (Figs. 290, 291). The first, which is the surer way, should, as a rule, be preferred, but the latter method is often the easier, especially in abdomino-anterior positions. Much has been written on the advantage to be gained by selecting the superior foot in version for transverse presentation; but as this view has never obtained much credence outside of England, and as Galabin, one of the latest British authorities, not only disapproves of this practice, but gives a very convincing mechanical proof of the fallacy of the theory which prompted it,



FIG. 292.—Method of reaching the foot by first passing the hand around the breech.

the subject need only be mentioned here. Unless special care be taken to select the superior foot, the lower foot is almost invariably seized.

Treatment of Neglected Transverse Presentations.—When a transverse presentation has been so long neglected that the release of the shoulder is thought to involve more danger to the mother than it would be justifiable to incur in the interests of the child, or when the child is already moribund or dead, one or the other of the appropriate destructive operations must be undertaken.

If the neck is at this time within reach, *decapitation* should be selected. If the process of spontaneous evolution has gone so far that it would be difficult or impossible to apply the decapitator to the neck, an *exenteration* should be chosen, and after the abdomen and the thorax have been emptied of their contents the operator must use his judgment as to whether it is safer to break the vertebral column and extract the child still doubled up upon itself, or to draw the fetal pelvis into that of the mother by traction with the fingers from within its cavity.

7. PROLAPSED EXTREMITIES.

Presentation of the Head and a Hand.—When a hand prolapses and enters the pelvis with the head, it is most commonly placed at one end of the bitemporal diameter. Its presence then generally results in delay through the increased size of the presenting part, and it may occasionally interfere with rotation. If the hand is placed against the occipital end of the head, its presence may delay the descent of the occiput and thus produce extension at the brim. This abnormality usually causes a delay sufficient to induce exhaustion on the part of one or the other patient, and thus indicates operative interference; but if such an indication does not arise, the ultimate result in most cases is that the head slips by the prolapsed arm, after a greater or longer period of delay, and is thus eventually born by a natural labor.

Prognosis.—If the presentation is detected early, the prognosis is little different from that of normal labor, and even when detected after a moderately long second stage it is influenced by the treatment, and should never be grave.

Treatment.—An attempt should be made to push back the prolapsed hand with the fingers, and, if extension has occurred, to restore flexion by pressure upon the forehead with the hand. Should this effort fail, an operative delivery must be resorted to, the choice of operation depending upon the position of the head. If good flexion is present, the forceps should be applied, but care must be taken to introduce the blade between the hand and the head, and great care will be necessary to avoid fracture of the fingers, the hand, or the wrist. If the application fails to do injury, the prognosis of the operation is good, since the tractile force is applied to the head while the hand is still exposed to friction against the pelvis; the head thus always slips past the hand. When marked extension is present, if manual flexion fails or if the head is already much moulded toward the configuration of a brow, internal podalic version should be performed.

Presentation of a hand and a foot is decidedly more rare than the above; its prognosis and treatment are, however, similar.

IV. DYSTOCIA

1. ANOMALIES IN THE FORCES OF LABOR.*

In a normal labor the active forces of expulsion (the uterine and abdominal muscles) and the passive forces of resistance (the fetus, the pelvis, and the maternal soft structures) are so nicely balanced that the expulsive forces are just sufficiently resisted to ensure a slow and gradual passage of the fetus along the birth-canal. The walls of the birth-canal and the structures around the vulvar orifice are by this arrangement slowly and gradually dilated, and are not rudely torn apart, as they would be by a more rapid expulsion of the fetus. This balance between the powers of labor, however, is easily disturbed. There may be anomalies by deficiency and anomalies by excess in the component parts of the forces of expulsion and in all the sources of resistance. Thus the uterine muscle may be too weak or too strong compared with the resistance it must overcome; and so also with the action of the abdominal muscles. The resistance furnished by the pelvis, the soft structures, and the fetus may be excessive or deficient.

1. DEFICIENT POWER OF THE UTERINE MUSCLE; INERTIA UTERI.

In this condition the uterine muscle is unable to overcome the normal resistance offered by the weight of the fetal body, by the friction of the pelvic walls, and by that of the undilated maternal soft structures. Inertia uteri is manifested in the vast majority of cases during the first stage of labor. The weakened uterine force therefore is almost always neutralized by the obstruction of an undilated cervix. There is scarcely another condition in obstetric practice that can be traced to such a variety of causes or that demands so many different plans of treatment.

Etiology.—Deficient power of the uterine muscle in labor may be due to a defect of the muscle itself, to some anomaly of innervation, or to a mechanical interference with the full and effective action of the muscle. Examples of the first-named cause may be found in imperfect development of the womb or in anomalies of development, as in *uterus bicornis*. The uterine muscle may be exhausted by rapidly-succeeding pregnancies. It may be over-distended by twins or by hydramnios, thus losing the power gained by cohesion of muscular bundles. The uterus may be weakened by some cause—as an adynamic fever or a wasting disease—that weakens the whole organism, but it does not necessarily follow that uterine weakness always accompanies a reduction of body-strength. The writer has seen women in the last stages of phthisis or in the midst of an attack of typhoid fever or pneumonia exhibit a uterine power in labor above the normal. The uterus may be weakened by profuse hemorrhage, as in placenta previa. It may be rendered incapable of exerting normal force in dry labors. The liquor amnii having drained off completely early in the first stage, the uterus retracts upon the child's body, thus being subjected in

* The superior figures (¹) occurring throughout the text of this article refer to the bibliography given on page 572.

certain regions to severe and long-continued pressure, and becoming in those spots anemic and friable, while in the areas free from the pressure of the child's body the uterine wall becomes congested, swollen, and edematous. Above all, the uterine muscle may become fatigued. This is the commonest cause of uterine inertia. It is seen oftenest in primiparæ, in whom inertia is more than twice as common as in multiparæ on account of the difficulty of dilating the rigid cervical tissues. Inertia may appear in consequence of any serious obstruction in labor. At first the pains are feeble, infrequent, and inefficient, but as labor continues the uterine contractions gather force. The inertia from this cause is likely to be only temporary, seen at intervals between periods of stormy uterine action or of long-continued tonic spasms, until finally exhaustion of the whole organism threatens the patient's life or the uterus ruptures.

It has been asserted that an anomaly of innervation in the anatomical sense, a deficient supply of the terminal nerves in the individual muscle-cells, is a cause of uterine inertia, but it is not yet clearly demonstrated to be so. An inhibitory nervous impulse to the uterine muscle, on the contrary, is a frequent cause of uterine inaction. It is the result of some emotion or of excessive pain. That the "doctor has frightened the pains away" on his first arrival has become proverbial in the lying-in room. The presence of any one who is a cause of embarrassment or is disagreeable to the patient may have the same effect. In hyperæsthetic women the uterine contractions may be so exquisitely painful that their first onset is followed by an inhibitory impulse which cuts them short almost immediately. Every clinical observer has seen the phenomenon of rapidly-recurring, very painful uterine contractions, which are, however, of short duration, and which secure no appreciable dilatation of the cervical canal. A woman may be tortured thus for hours in the early part of the first stage of labor, when this inhibitory nervous impulse is commonly observed. With the continuance of labor the individual becomes more or less indifferent to her surroundings or more inured to suffering, and the inhibitory nerves, probably derived from the spinal cord, apparently lose the power of responding to the stimulus of pain.

Among the mechanical causes of inefficient uterine action during labor are fibroid tumors of the uterine walls, displacements of the womb, old peritoneal adhesions, and fresh outbreaks of periuterine inflammation.

Diagnosis.—The recognition of uterine inertia should always be easy. The contractions of the muscle are of short duration and are separated usually by long intervals, and by palpation the observer may convince himself that they are feeble. The uterus during the pain does not assume that intensely hard consistency which normal vigorous action of the muscle in labor occasions. The patient's expression, action, and demeanor point to deficient force during the pains. The woman is more placid, the face is less contorted, and there is less outcry during the contractions than in the normal parturient patient, except in those cases in which excessive pain inhibits uterine action. In these cases, however, abdominal palpation and the short duration of the pains are suf-

sufficiently plain signs of the inertia. Finally, labor is delayed. During the first stage dilatation is slow or does not progress at all, and in the second stage the presenting part does not advance. One fatal error in the diagnosis of inertia uteri should be avoided: the physician should be sure that labor is not delayed by some obstruction. It has happened in a careless and superficial examination that the observer has taken the distended and thinned lower uterine segment for an inert womb. In such a case the measures adopted to stimulate the supposedly inactive uterine muscle to overcome an obstacle that is insuperable might easily be interrupted by rupture of the womb. A methodical and careful examination will guard one from this error. The source of obstruction will be discovered. The firmly, perhaps tetanically, contracted upper uterine segment may be contrasted with the inactive lower segment by palpation of the whole anterior surface of the womb. The contraction-ring should be visible, and the whole uterus stands out with unusual prominence, from the anteversion that always accompanies prolonged and powerful uterine contraction.

Treatment.—From the diversity in the causes of inertia uteri it follows that no single plan of treatment can be depended upon. If uterine action is inhibited by emotion, the cause of nervous disturbance should, if possible, be removed. An objectionable person should leave the room. If excessive pain prevents effective contractions, an analgesic should be administered. Nothing is better for this purpose than chloral administered in 15-grain doses, repeated, if necessary, twice at intervals of fifteen minutes. A quarter of a grain of morphia hypodermatically comes next in order of efficiency. If the uterine muscle is simply apathetic, it can be aroused by some direct irritant. The insertion of a bougie as for the induction of labor answers the purpose well. A more effective but more troublesome measure is the dilatation of the cervical canal by Barnes's bags. These not only irritate the uterine muscle and thus bring on strong contractions, but they also artificially dilate the cervical canal, and thus relieve the uterine muscle of a great part of its task in the first stage of labor. If the head should be well engaged in the pelvis, however, the insertion of the bags is difficult and they are likely to cause malpositions of the head. In such cases, if the os is dilated to the size of a silver dollar, nothing is so effective as the application of forceps—not with the idea of dragging the head through the undilated cervical canal, but to pull the head at intervals firmly down upon the cervix. The impact of the head upon the cervix acts as a powerful reflex irritant, and will excite as strong contractions as any direct irritant can do. Not only so, but the pull of the head upon the cervix will gradually dilate the canal as effectually as could strong propulsion from above. As soon as effective pains are established and the dilatation of the cervical canal progresses satisfactorily the forceps should be removed.

Inertia uteri so profound as to demand the somewhat radical measures just described is, fortunately, rare. More commonly the physician sees the minor grades, in which there is simply a flagging of uterine effort during the first

stage, especially in primiparæ, accompanied by every evidence of temporary physical and mental exhaustion. After a period of rest effective contractions will reappear, even if nothing whatever is done to aid the patient. The more complete the rest, the more vigorous will be the uterine action when it is resumed, and for this reason the administration of chloral and opium is often followed after a time by a satisfactory progress in labor. But these drugs necessarily retard the termination of labor by the time of rest they secure. It is ordinarily desirable, therefore, to resort to drugs of a stimulant character that shall at once revive the flagging uterus and so hasten the delivery. Many medicaments have been recommended for this purpose, but, of them all, alcohol, quinin, and ergot alone deserve consideration. The last was employed extensively at one time, but clinical experience forbids its use to-day. The contractions of the womb induced by ergot are likely to become tetanic. The uninterrupted contractions interfere with the fetal circulation; they may cause fatal intra-uterine asphyxia, and they often produce such exaggerated blood-pressure and stagnation of the current in the fetal body as to induce extravasations in important viscera, especially the brain. Further, the circular fibres of the cervix come under the influence of the drug, and by their firm contraction neutralize the contraction of the longitudinal fibres of the uterine body, and thus retard labor almost indefinitely; and, worst of all, should there be some obstruction to the descent of the child in the maternal pelvis or in the fetal body, the administration of ergot predisposes to rupture of the uterus. For these sufficient reasons this drug as a stimulant to the uterine muscle in the first and second stages of labor should be banished from the obstetrician's pharmacopeia, except in the single instance of the birth of the second of twins (see p. 569). Owing to the recommendations of Albert H. Smith and of Fordyce Barker, quinin has had, and still has, a great reputation as a stimulant to the uterus in labor. The writer's experience with the drug, however, does not permit him to subscribe to a belief in its efficacy as a uterine stimulant in labor. Quinin has the positive disadvantage, moreover, that it will occasionally in certain susceptible individuals produce a violent post-partum hemorrhage. In the minor grade of inertia under description, so often seen in primiparæ, and almost always the result of exhaustion, the writer has found nothing so useful as alcohol, in the shape of a wineglassful of sherry, taken slowly with a cracker, and given with the positive assurance that it will bring back the pains and hasten the conclusion of labor, for the patient needs moral and mental support as much as she requires a physical and muscular stimulus.

An impression prevails among general physicians that inertia uteri in the first stage of labor, before rupture of the membranes, may safely be disregarded. In a measure this view is correct. The writer has seen in a number of instances a partial dilatation of the os and then an entire cessation of uterine contractions for many hours and even for days. In one case the cervical canal was sufficiently dilated to receive four fingers, and it remained so for more than a week, the patient all the while going about on her feet in per-

fect comfort, without a single painful contraction of the womb. But should inefficient uterine contractions be accompanied by much pain, as happens in some cases of inertia, the long-continued first stage should not be regarded with indifference. The patient will in time show the irritant and depressant effects of long-continued suffering in an elevated temperature, an accelerated pulse, and a lessened resisting power of body-cells, the last playing an important rôle in the predisposition to sepsis after labor. Another consequence of delayed, painful labor may be seen in a sensitive, nervous individual, who is thrown into a state of excitement—who from gloomy forebodings of harm to herself and to her infant passes into an almost maniacal condition of terror and dread.

It should be a rule of practice, therefore, to watch carefully all cases of inertia uteri, and to interfere as soon as the patient's mental condition or her pulse, temperature, and general vigor are demonstrably affected by the delay in labor.

2. EXCESSIVE POWER IN THE EXPULSIVE FORCES OF LABOR.

An actual excess of power in the expulsive forces (the uterine and abdominal muscles) in labor sufficiently great to expel the fetus precipitately is extremely rare. A relative excess is not uncommon. The child's body may be so small, the pelvis so abnormally large, the maternal soft parts so relaxed, that the ordinary power exerted by the uterine and abdominal muscles is far in excess of that required to overcome the weak resistance offered, and the child is fairly shot out of the birth-canal. The rapid delivery may cause serious results to both mother and child. In the woman the structures on the pelvic floor may be lacerated severely; the sudden evacuation of the womb predisposes to hemorrhage from inertia; the placenta may be detached prematurely; and the sudden evacuation of the abdominal cavity predisposes to dangerous syncope. For the child the chief danger is the possibility of unexpected delivery of the mother in the erect posture. The umbilical cord may rupture, and the child, falling to the ground, may be injured fatally. Precipitate and unexpected labors occur most frequently when women are seated upon the water-closet. The child is evacuated into the waste-pipe or down a well, and may be destroyed. Some astonishing examples of infantile vitality, however, are furnished by such cases. In one instance a woman was unexpectedly delivered while seated upon the commode in a railway train moving at the rate of thirty miles an hour. As soon as she could communicate the startling intelligence to the conductor the train was backed until, several miles from the place where it was stopped, the infant was found upon the railway ties alive and well!* In another case, under the writer's observation, a young woman purposely discharged her fetus at term into the well of a privy twelve feet deep. Three bricks were thrown or fell down the well after the child and lay across its body. Eight hours after its birth the infant

* Professor William Osler told the writer of this remarkable occurrence. It happened on the Canadian Pacific Railroad.

was fished out of the bed of manure in which it was immersed to the neck, unharmed and in good condition.

Unfortunately, the physician is usually not at hand to prevent a precipitate delivery and to avert its consequences. Should he find an infant descending the birth-canal with a rapidity dangerous to itself and to its mother, he can easily retard its progress by pressure with his hand against the presenting part.

3. DEFORMITIES OF THE PELVIS.

Comprehensive and satisfactory knowledge of deformities in the female pelvis has been gained only in the latter half of the present century, since the appearance of Michaelis' work in 1851.¹ Until the announcement by Arantius in the last quarter of the sixteenth century that a contracted pelvis is a serious obstacle in labor, the prevailing belief had been that difficult labors from mechanical obstruction by the maternal bones were due to a failure on the part of the pelvis to expand sufficiently for the passage of the child. This idea continued in force for a number of years after Arantius' time. According to Litzmann, Heinrich von Deventer (1651-1724) should be regarded as the real founder of our knowledge of the pelvis and of its anomalies. He described the inclination of the pelvis, the axis of the pelvic inlet, the contracted pelvis, and the flat pelvis. Pierre Dionis was the first to point out (1718) the relationship between rachitis in childhood and a deformed pelvis in the adult. William Smellie's contributions to the study of the female pelvis were remarkably full and clear, when one considers how little was known before his time. His description of the rachitic pelvis, his reflections on its cause, and his accounts of illustrative cases may be read with profit to-day. Roederer, Stern, Cooper, Vaughan, Denman, Baudelocque, and Fremerly added much to the stock of knowledge during the latter half of the eighteenth century. The men of the present century to whom we owe most of our present information about the pelvis and pelvimetry are Naegele, Kilian, Rokitansky, Michaelis, Robert, Litzmann, Neugebauer, and many others to whom reference will be made in the sections devoted to the particular varieties of deformed pelvis.²

Frequency of Deformed Pelves.—It is difficult to estimate the frequency in America of pelves sufficiently deformed to influence decidedly the course of labor. Statistics from our lying-in hospitals afford little aid to a correct conclusion, because the inmates are chiefly European immigrants and negroes. In the Boston Lying-in Hospital, however, deformed pelves were found in 2 per cent. of native-born and in 6 per cent. of foreign-born women (Reynolds).³ The writer's experience in private and consulting practice convinces him that deformed pelves are by no means rare among native-born women in the densely-populated centres of the Eastern States. No general practitioner, in a large city at least, can hope to avoid such cases, and it is likely that each year will afford him one or more striking examples. It follows that an ability to recognize deformities of the female pelvis is a necessary equipment for every

practitioner of medicine who may be called upon to attend women in confinement, and that a knowledge of pelvimetry is as essential to the intelligent and successful practice of obstetrics as are percussion and auscultation to the practice of medicine. European statistics bearing on the frequency of contracted pelves give the following results: Michaelis found in 1000 parturient women 131 contracted pelves; Litzmann, 149. Winckel found in Rostock 5 per cent., in Dresden 2.8 per cent., and in Munich 9.5 per cent. of contracted pelves among pregnant and parturient women. Winckel believes that 10 to 15 per cent. of childbearing women have contracted pelves, but that in only 5 per cent. is the obstruction serious enough to be noticed. Kaltenbach puts the frequency of contracted pelvis at 14 to 20 per cent. In Marburg it was found to be 20.3 per cent., in Döttingen 22 per cent., in Prague 16 per cent. Schauta estimates it at 20 per cent.

Classification of Anomalies in the Female Pelvis.—All classifications are merely a convenience for the teacher and student. It is rarely possible to draw sharply-defined lines between varying manifestations of a condition. The majority of German authors follow Litzmann's classification of abnormalities of the female pelvis, by which they are broadly divided into those of size and those of shape. Modern French authors adopt the still less satisfactory division of over-size, under-size, and anomalies of inclination. The writer finds Schauta's classification the most convenient, and therefore utilizes it, with some slight modification.⁴

ANOMALIES OF THE PELVIS THE RESULT OF FAULTY DEVELOPMENT.

Simple flat;
Generally equally-contracted (justo-minor);
Generally contracted flat (non-rachitic);
Narrow funnel-shaped, fetal or undeveloped;
Imperfect development of one sacral ala (Naegele pelvis);
Imperfect development of both sacral alæ (Robert pelvis);
Generally equally-enlarged (justo-major);
Split pelvis.

ANOMALIES DUE TO DISEASE OF THE PELVIC BONES.

Rachitis;
Osteomalacia;
New growths;
Fractures;
Atrophy, caries, and necrosis.

ANOMALIES IN THE CONJUNCTIONS OF THE PELVIC BONES.

Abnormally firm union (synostosis), which is apt to be found in elderly primiparæ, particularly at the sacro-coccygeal joint:
Of symphysis;
Of one or both sacro-iliac synchondroses;
Of sacrum with coccyx.

Abnormally loose union or separation of the joints :
 Relaxation and rupture ;
 Luxation of the coccyx.

ANOMALIES DUE TO DISEASE OF THE SUPERIMPOSED SKELETON.

Spondylolisthesis ;
 Kyphosis ;
 Scoliosis ;
 Kypho-scoliosis ;
 Lordosis.

ANOMALIES DUE TO DISEASE OF SUBJACENT SKELETON.

Coxalgia ;
 Luxation of one femur ;
 Luxation of both femora ;
 Unilateral or bilateral club-foot ;
 Absence or bowing of one or of both lower extremities.

Diagnosis of Pelvic Anomalies: Pelvimetry.—Deformities of the female pelvis may be detected by the history of the patient, by her appearance, by palpation of the exterior and interior of the pelvis, and by external and internal measurements of those pelvic diameters that are accessible, or of



FIG. 293.—Modern combination of Bau-deloque's and Oslander's pelvimeter.

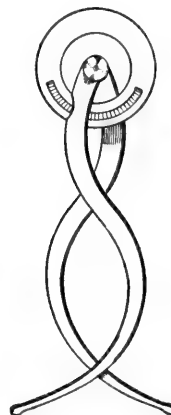


FIG. 294.—Oslander's pelvimeter.

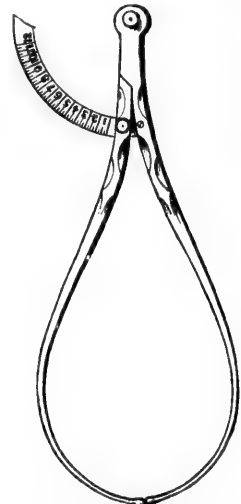


FIG. 295.—Martin's pelvimeter.

salient points on the woman's body corresponding as nearly as possible with the internal measurements desired ; the relations between the two last having been ascertained by many observations on dead and living bodies. For taking

pelvic measurements the examiner's fingers, a tape measure, and a modified mathematician's callipers—a pelvimeter—are usually employed. Baudelocque (1775) was the first to devise the pelvimeter in ordinary use. He laid the foundations of pelvimetry, and his instrument and methods are in use at the present time (Figs. 293–296). It is convenient to describe the measurements of the diameters of the pelvic inlet, pelvic cavity, and pelvic outlet separately.

Measurement of the Antero-posterior Diameter of the Superior Strait.—This measurement, the most important in the pelvis, cannot be taken directly. It must be estimated by several plans. Baudelocque was the first to point out the relation between the measurement from the depression under the last spinous process of the lumbar vertebræ to the upper edge of the symphysis pubis, and the true conjugate diameter of the pelvic inlet. To this

external measurement the name “external conjugate” was given, but it is often called “the diameter of Baudelocque” (Fig. 298). Its discoverer believed the relation between the external and internal diameters to be constant—that the one exceeded the other by 8 to 8½ centimeters—but in this he was mis-

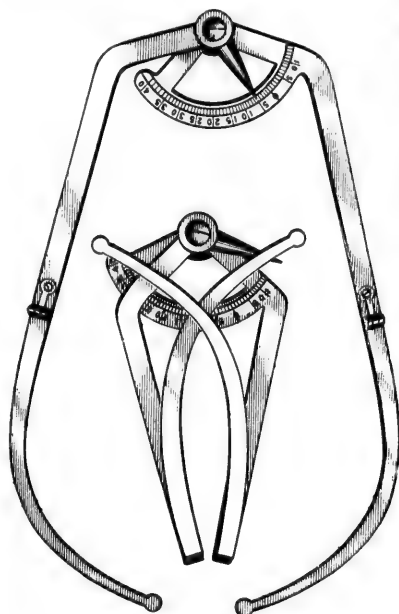


FIG. 296.—Harris-Dickinson portable pelvimeter.

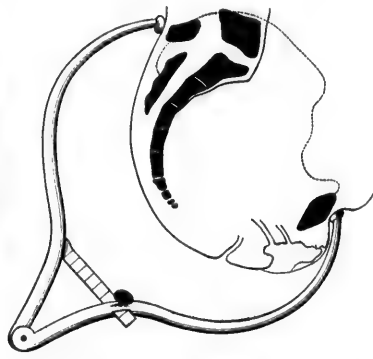


FIG. 297.—Measuring external conjugate.

taken. The line of the external diameter does not usually coincide with the line of the internal, and the thickness of bones and superimposed structures differs, of course, in each individual. In 30 cases in which Litzmann had an opportunity to compare the measurement of the external conjugate taken during life with the actual measurement of the true conjugate taken after death, there was an average difference of 9.5 centimeters, but the maximum difference was 12.5 centimeters and the minimum 7 centimeters—a variation of 5.5 centimeters in this small number of cases. Michaelis found a difference of 0.6 to 3.2 centimeters, and Schroeder 1¼ to 3 centimeters between the external conjugate of the living body and that of the dried specimen. The

measurement of the external conjugate, therefore, is not to be relied upon in making an estimate of the size of the true conjugate. It simply serves to indicate the probability or the improbability of pelvic contraction. An external conjugate of 16 centimeters or under means certainly an antero-posteriorly contracted pelvis; between 16 and 19 centimeters the pelvic inlet will be contracted in more than half the cases; between 19 and 21.5 centimeters there



FIG. 298.—Measuring the external conjugate diameter upon the living female.

will be but 10 per cent. of contracted pelves; and above 21.5 centimeters it is almost certain that the conjugate diameter of the pelvic inlet is not contracted at all. The external conjugate cannot be measured accurately without some practice. The beginner in pelvimetry will do well to remember the following rules:

Have the patient dressed for bed. Place her upon her side, with the thighs slightly flexed and the clothing rolled well up out of the way, the lower part of the body being covered with a sheet. The examiner stands at the patient's back, facing her head. The depression below the last spinous process of the lumbar vertebrae is found by rubbing a finger-tip over the lumbar spines from above downward until the finger sinks into the depression sought and feels no more prominent spinous processes below.* The knob at the end of one branch of the pelvimeter is placed firmly in this depression, and is held

* Michaelis preferred the measurement from the tip of the last lumbar spinous process, instead of from the depression below it.

there with one hand while the fingers of the other hand find a point on the symphysis pubis about $\frac{1}{8}$ of an inch below its upper edge, on which point the other branch of the pelvimeter is firmly set; the pelvimeter having been so placed that the indicator is turned toward the examiner, the measurement is therefore easily read off as soon as the pelvimeter is in proper position. It is on the average, in well-built women, $20\frac{1}{4}$ centimeters.

The best means for determining the length of the antero-posterior diameter of the pelvic inlet are the measurement taken from the lower edge of the symphysis pubis to the promontory of the sacrum, the diagonal conjugate diameter, and the distance between the upper outer surface of the symphysis pubis and the promontory of the sacrum. The diagonal conjugate diameter is one side of a triangle the other two sides of which are the height of the symphysis and the true conjugate. The distance between the outer upper surface of the symphysis and the promontory of the sacrum differs from the true conjugate by the thickness of the upper portion of the symphysis. Smellie was accustomed to estimate roughly the length of the true conjugate by a digital

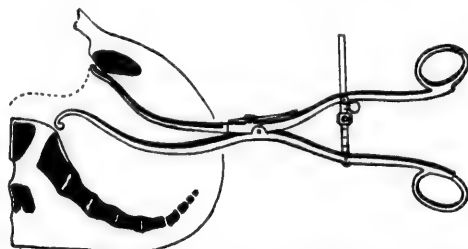


FIG. 299.—Stein's instrument for direct measurement of the conjugate.

examination, basing his estimate on the ease with which the promontory could be reached. In the latter part of the eighteenth century Johnson⁶ proposed for estimating the size of the pelvic inlet a method which consisted in inserting the fingers of one hand in the mouth of the womb and then spreading them between the promontory and the sacrum. A few years later the elder Stein devised a graduated rod for measuring the distance between the lower edge of the symphysis pubis and the division between the second and third sacral vertebrae. This distance he believed to be $\frac{1}{2}$ to 1 inch greater than the true conjugate. Stein later constructed the instrument for the direct measurement of the conjugate shown in Figure 299. Many instruments have since been constructed on this principle, but they are impracticable in the living female, for obvious reasons. Baudelocque was the first to propose the measurement of the diagonal conjugate and the subtraction from it of an average figure ($\frac{1}{2}$ inch) to determine the length of the true conjugate. His method, exactly as he described it, is still in use, with the exception that two fingers instead of one are employed in measuring the distance between the symphysis and the promontory. To measure the diagonal conjugate correctly the examiner must have the skill that comes of practice, and he must conduct his examination in

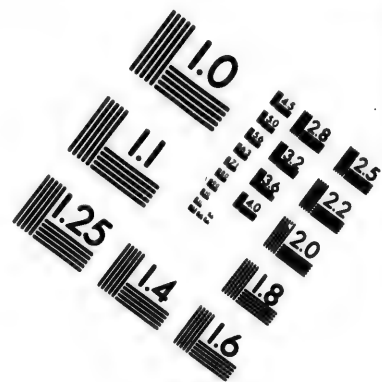
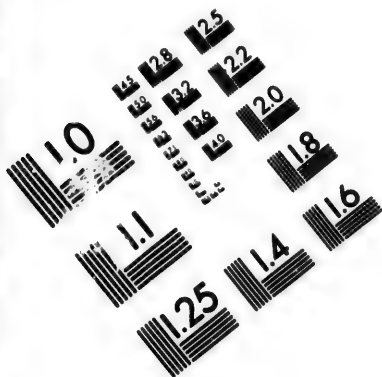
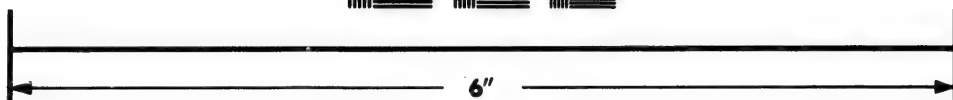
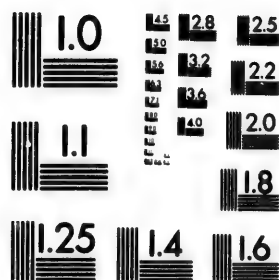


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a careful and methodical manner. The patient is put in the lithotomy position and is brought to the edge of the table or bed on which she lies, so that the buttocks project well over it. The examiner cleanses his left hand and anoints the first two fingers with an unguent; he then inserts these fingers, held stiffly extended, inward and upward till the tip of the second finger finds and rests upon the promontory of the sacrum. Care must be exercised not to take the last lumbar for the first sacral vertebra or *vice versa*, nor the second for the first sacral vertebra—mistakes easily made in cases of so-called “double promontory.” With the tip of the second finger resting firmly in place upon the middle line of the promontory the radial side of the hand is elevated until upon it is plainly felt the im-



FIG. 300.—Measuring the diagonal conjugate diameter.

press of the arcuate ligament under the lower edge of the symphysis. With a finger-nail of the other hand a mark is made upon this point of the examining hand, which is then withdrawn (Fig. 300). The distance between this mark and the tip of the middle finger held extended is taken by a

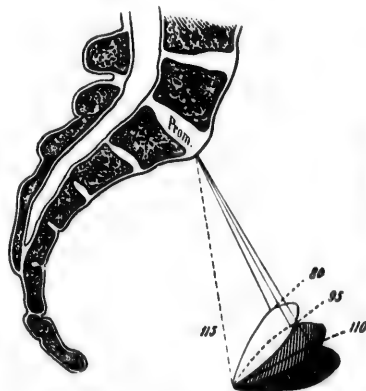


FIG. 301.—Effect of different inclinations of the pubis upon the relationship between the true and the diagonal conjugate diameter (Ribemont-Dessaignes).

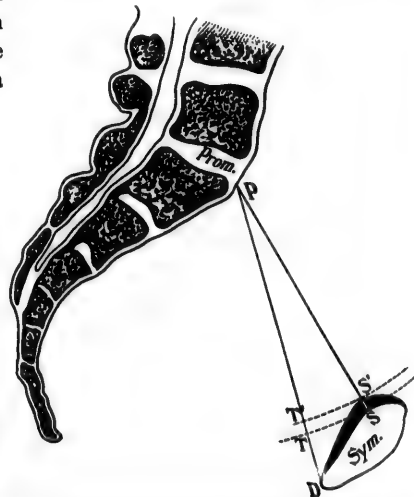


FIG. 302.—Effect of different thicknesses of the symphysis upon the relationship between the true and the diagonal conjugate diameter (Ribemont-Dessaignes).

pelvimeter. This distance is the diagonal conjugate. By the observation of

many subjects, alive and dead, an agreement has been reached that $1\frac{1}{2}$ centimeters should be subtracted from the diagonal conjugate to obtain the true conjugate diameter. But the acceptance of this average difference depends upon a normal height of the symphysis, 4 centimeters.

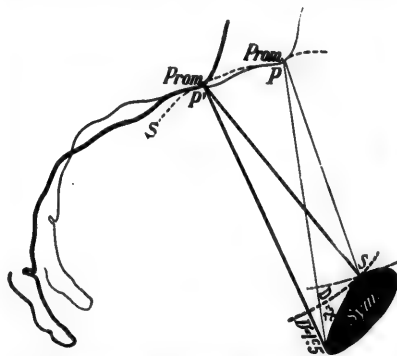


FIG. 303.—Effect of different heights of the promontory upon the relationship between the true and the diagonal conjugate (Ribemont-Dessaignes).

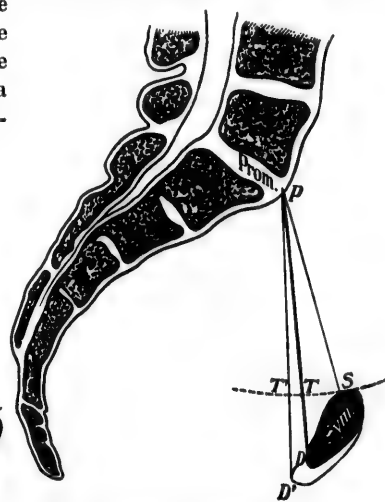


FIG. 304.—Effect of different heights of the symphysis upon the relationship between the true and the diagonal conjugate diameter (Ribemont-Dessaignes).

meters, a normal angle between the axis of the pubis and the true conjugate, 105° , a normal thickness of the symphysis, and a normal height of the promontory (Figs. 301–305).

These factors, however, are not constant, and if they vary much from the normal the most skilful and most experienced obstetrician may be misled wofully in his estimation of the true conjugate. The writer has had under his care a rachitic dwarf in whom there was more than 3 centimeters' difference between the diagonal and true conjugates, and Pershing found among 90 pelvis in the museums of Philadelphia a difference varying from 0.8 centimeter to 3.6 centimeters. It is declared that these sources of error may be eliminated by the following corrections: For every degree of increase in the conjugato-symphyseal angle add half the number of millimeters to the sum to be subtracted from the diagonal conjugate, and vice

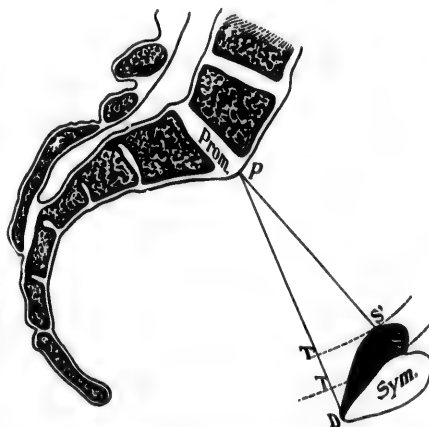


FIG. 305.—Effect of the lessened slant outward of the symphysis in a rachitic pelvis upon the relationship between the true and the conjugate diameter (Ribemont-Dessaignes).

the sym-
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ion of

versd; also, for every 0.5 centimeter increase in the height of the symphysis over the normal add 0.3 centimeter to the sum to be subtracted from the diagonal conjugate, and *vice versd*. While these rules are admirable for the study of the dried specimen in a museum, they are not easily applied to the living pregnant female. The height of the symphysis can be measured in the living subject, but an allowance for variations in this respect eliminates error in only a small proportion of cases. The variations in the angle of the symphysis, a much more important source of error, can only be surmised. The writer much prefers the measurement between the upper outer edge of the symphysis pubis and the promontory of the sacrum for the estimation of the true conjugate, having demonstrated its superior accuracy in practice.⁶ For taking this measurement the patient is put in the dorsal position, with the

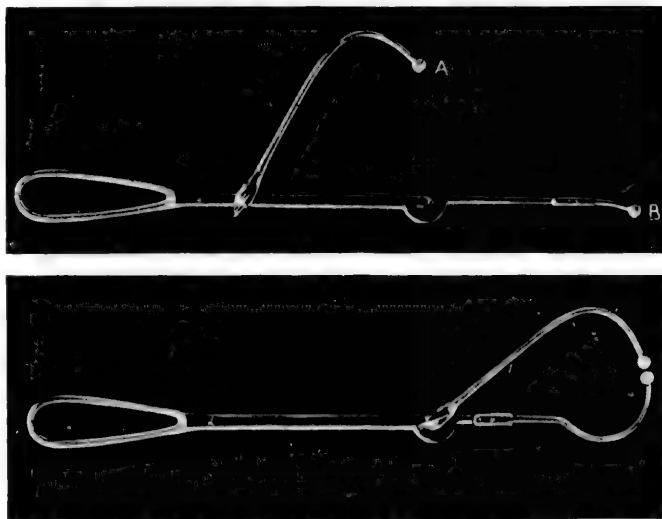


FIG. 306.—Hirst's pelvimeter: A, for measuring the true conjugate plus the thickness of the symphysis; B, with extra tip added for measuring the thickness of the symphysis.

buttocks projecting beyond the edge of the table or bed on which she lies. A mark with the point of a lead pencil is made on the skin over the symphysis pubis, about $\frac{1}{8}$ of an inch below the upper edge. The two fingers of the left hand are inserted in the vagina as in measuring the diagonal conjugate. The tip of the middle finger, having found the middle line of the promontory, is moved a little to the patient's right, and tip B of the pelvimeter, shown in Figure 306, is made to take its place. While the examining physician holds the shaft of the pelvimeter firmly in place an assistant adjusts tip A of the movable bar over the mark made on the symphysis. This bar is then screwed tight, the whole pelvimeter is removed, and the distance between the tips is found by a tape measure. This distance is the conjugate plus the thickness of the symphysis (Fig. 307). The latter the writer has found to be

1 centimeter in twenty-six dried pelves, $1\frac{1}{4}$ centimeters in nine, $1\frac{1}{2}$ centimeters in thirteen, $1\frac{3}{4}$ centimeters in four, and 2 centimeters in three specimens, one a high-grade rachitic pelvis, another of the masculine type, and the third a justo-major pelvis. The thickness of the symphysis is measured as shown in Figure 308. In living subjects the index finger of the left hand must find the inner surface of the symphysis pubis, and follow it up to within about $\frac{1}{4}$ of an inch of the top, where it bulges to its full thickness. On this point one tip of the pelvimeter is placed, and it is then held in position between the ends of the first and second fingers; the other tip of the instrument is adjusted over the mark made on the skin externally: the distance is read off from the indicator provided for the purpose. It is not necessary to make an allowance for the thickness of the tissues over the symphysis, for this is included in both measurements, and on subtracting one from the other the necessary correction is of course made. The tissues over the inner surface of the symphysis can usually be so compressed by the knob of the pelvimeter as to be practically eliminated. If this is impossible, as may happen in some primipare, a small allowance may be made for these tissues—say, at the most 0.5 centimeter. In taking this measurement it may be necessary to anesthetize the patient; and this is well worth while if a decision between some of the more serious obstetrical operations is to be based, as it must be, upon an accurate estimation of the true conjugate.*



FIG. 307.—Measuring the true conjugate plus the thickness of the symphysis.



FIG. 308.—Measuring the thickness of the symphysis.

Measurement of the Transverse Diameter of the Superior Strait.—The

* Wellenbergh was the first to employ this principle in pelvimetry. His pelvimeter was improved upon by Van Huevel, and in recent times by Skutsch and by Bullitt (*Deutsche medizinische Wochenschrift*, No. 13, 1890; *American Journal of Obstetrics*, 1893; Müller's *Handbuch der Geburtshilfe*, vol. ii. pp. 255, 260, 261).

transverse diameter of the pelvic inlet cannot be measured directly, nor can it be estimated accurately. Fortunately, this is not necessary. It answers the requirements of practice to determine whether there is a diminution of this measurement, without determining the exact degree of lateral contraction. To do this the following measurements are relied upon: The distance between the anterior superior spinous processes of the iliac bones, which in well-formed women is 26 centimeters; the distance between the crests of the iliac bones, 29 centimeters; the distance between the trochanters, 31 centimeters; the distance between the posterior superior spinous processes of the iliac bones, 9.8 centimeters; the distance between the subpubic ligament and the upper anterior angle of the great sacro-sciatic notch, which, according to Löhlein, is 2 centimeters less than the transverse diameter of the inlet; finally, an estimation of the width of the pelvic inlet by a vaginal examination. In taking the external measurements the woman is placed upon her back. The salient points are easily found except in the case of the iliac crests. They are discovered by

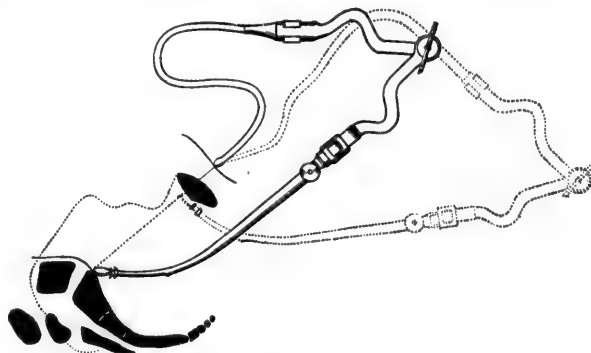


FIG. 309.—Skutsch's method of measuring the conjugate diameter.

moving the knobs of the pelvimeter evenly along the crests of the ilia until the two opposite points most widely separated from each other are found. If the crests are no farther, or even less, separated from each other than the spines, points 5 centimeters back of the latter are arbitrarily selected as the sites of the crests. The posterior superior spinous processes are often marked by distinct dimples on the woman's back. The internal measurement of Löhlein is made by the fingers in the vagina. If all these measurements are much less than normal, a lateral contraction of the pelvis may be assumed, and the degree of contraction is roughly estimated by the amount of decrease in the measurements, although the relations between these measurements and the distance sought is very variable. The efforts of Skutsch and of others before him accurately to measure the transverse diameter of the pelvic inlet by combined internal and external measurements cannot be said to have yet been crowned by success. The softness of the tissues externally permits the external knob of the pelvimeter to sink into the flesh to a varying degree, and the same is true of the structures within the pelvis. It is difficult also to keep the pel-

vimeter in the same straight line when the internal knob is changed from one side to the other (Figs. 309, 310). Moreover, better results in practice may be obtained by an estimate formed by a vaginal and a combined examination, under anesthesia if necessary, of the relative size of the transverse diameter of the pelvic inlet and the antero-posterior diameter of the child's head.

Measurement of the oblique diameters of the pelvic inlet is required only in obliquely-contracted pelves. It will be referred to in the description of these pelves.

The Measurement of the Capacity of the Pelvic Cavity.—The capacity of the pelvic cavity must be estimated by vaginal examination. There is no

plan by which accurate measurements can be made. It is sufficient to estimate the size and the shape of the pelvic canal by palpating the lateral walls of the pelvis; by determining the curve, perpendicularly and laterally, of the sacrum; by noting the height of the sacro-sciatic notches,

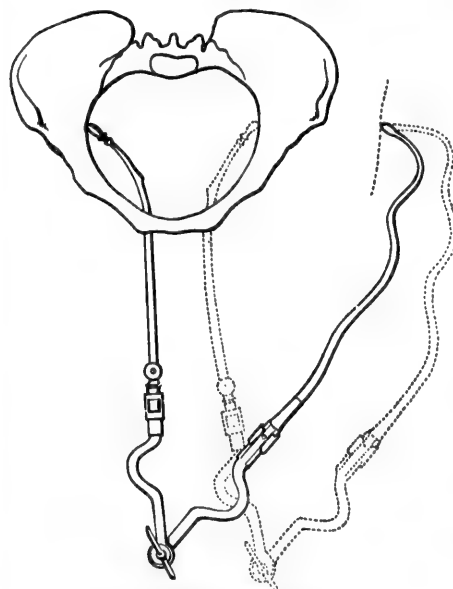


FIG. 310.—Skutsch's method of measuring the transverse diameter of the pelvic inlet.



FIG. 311.—Measurement of the antero-posterior diameter of the pelvic outlet.

the approximation of the tuberosities of the ischia, the depth of the pelvis, and the direction of its canal; by detecting, possibly, the presence of an exostosis, an osteosarcoma, an abnormally-projecting spinous process, an old fracture, or asymmetry of the pelvic walls from any cause.

Measurement of the Transverse Diameter of the Pelvic Outlet.—The antero-posterior diameter of the inferior strait is enlarged during labor by the displacement backward of the coccyx. The transverse diameter between the tuberosities of the ischiatic bones is constant, and if there is contraction of the outlet the greatest resistance to the escape of the fetus is furnished by these firm bony eminences. The transverse diameter of the pelvic outlet can be measured directly with ease. The woman is placed in the dorsal position with thighs and legs flexed. The distance between the tuberosities of the

ischia is measured with a pelvimeter, or the examining physician places his thumbs squarely on the tuberosities, and an assistant measures the distance between the physician's thumb-nails.

If it should be desired to measure the *antero-posterior diameter of the pelvic outlet*, this may be done as shown in Figure 311, 1.5 centimeters being subtracted for the thickness of bone and superimposed structures.

4. DESCRIPTION OF THE SEVERAL VARIETIES OF ABNORMALITIES IN THE FEMALE PELVIS.

The **simple flat pelvis** (Fig. 312) is the earliest recognized form of contracted pelvis—the *pelvis plana* of Deventer, who did not, however, make a distinction between the simple flat and the rachitic flat pelvis. It is doubtful, indeed, if he knew the difference between the two. Betschler was the first to point out the distinctive features of this form of pelvis. In Europe it is the commonest variety of deformed pelvis. Schroeder states that it is seen more frequently than all the other forms put together. In America it is also common, but the equally generally-contracted pelvis is encountered here as often or perhaps oftener. Out of a series of 316 pelves in women of American birth the writer has found eighteen (a percentage of 5.6) with the measurements characteristic to some degree of a simple flat pelvis.

Characteristics.—In the simple flat pelvis the sacrum is small and is pressed downward and forward between the iliac bones, but is not rotated forward on its transverse axis. The antero-posterior diameter is contracted, therefore, throughout the whole of the pelvic canal. The contraction, however, is not often great. It is scarcely ever below 8, and is usually not under 9.5, centimeters.*

The transverse diameter is as great as, or possibly greater than, that of the normal pelvis. Occasionally, however, in pelves approaching the type of the generally-contracted flat pelvis the transverse diameter may be found somewhat diminished. There is in these pelves quite frequently a double promontory formed by the abnormal projection of the cartilaginous junction between the first and second sacral vertebrae. The line drawn between the lower promontory, or the second sacral vertebrae, and the symphysis is often as small as, or smaller than, the true conjugate.†

Etiology.—The simple flat pelvis has been ascribed to heredity, to an arrested rachitis, to overwork before puberty (especially the carrying of heavy weights), to premature attempts to walk or to sit up, and to the weight of a heavy trunk upon a pelvis ill fitted to bear it on account of weakness of its ligaments. It is probable that in the majority of these pelves the form is

* Engelken has described a specimen with a true conjugate of 4.8 centimeters, a diagonal conjugate of 7.5 centimeters, with transverse and oblique diameters of the inlet 13.3 and 12.4 centimeters respectively. This specimen is unique.

† Crédé found in nine pelves with a double promontory the conjugate from the true promontory longer in four and shorter in three cases than the conjugate measured from the false promontory. In two cases the two conjugates were of equal length (*Klin. Vorträge ueber Geburtshilfe*, Berlin, 1853).

inherited and congenital. It has been found by Fehling in a number of fetuses and new-born infants.

Diagnosis.—The simple flat pelvis is easily overlooked. There is nothing in the patient's appearance or history to suggest the deformity, unless she has had difficulty in previous labors. The characteristic signs are the diminished antero-posterior diameter, determined by internal and external measurements, and a transverse diameter as great as, or greater than, normal, or perhaps a trifle under the normal measurement. This last point is determined by measurements externally and by the internal palpation of the pelvic canal. In measuring the conjugate diameter of this pelvis one must take into account the lessened inclination of the symphysis outward, its height, somewhat below the normal, and the low position of the promontory. Usually the average sum of $1\frac{3}{4}$ centimeters is a sufficient amount to subtract from



FIG. 312.—Simple flat pelvis (model in Hirst Collection, University of Pennsylvania): c. v., 84 cm.; tr., 134 cm.; obl., 124 cm.*



FIG. 313.—The two conjugates of a double promontory (Ribemont-Dessaignes).

the diagonal conjugate. If there is a double promontory, as is frequently the case in this form of pelvis, the conjugate must be measured from the promontory nearest to the symphysis, usually the lower (Fig. 313).

Influence upon Labor.—From the failure of the presenting part to enter the pelvis during the last weeks of gestation there is frequently some degree of pendulous abdomen, especially in women with abdominal walls relaxed from previous pregnancies. The uterus is sometimes broader than common, and is often tilted to one side. The presenting part, if the head, may be loose above the superior strait, resting on one iliac bone or on the symphysis, or it may be pressed down firmly upon the brim in a transverse position, to accommodate its longest diameter to the longest diameter of the pelvic inlet. Malpresentations are common, as is also prolapse of the cord and of the extremities. The membranes may protrude in a cylindrical pouch from the external os as the liquor amnii is forced out of the uterus without obstruction from

* The abbreviations *tr.* and *obl.* will be used throughout to designate the transverse and oblique diameters of the pelvic inlet.

the imperfectly engaged head. From the same cause an early rupture of the membranes is likely. According to Litzmann, natural forces end the labor in 79 per cent. of cases, but in 50 per cent. the head is not fully engaged until the os is completely dilated. The dilatation of the os proceeds slowly, for the head does not descend low enough to press upon the cervix. Consequently the dilatation must be effected by a retraction of the cervix over the head or by the distended membranes. Should these rupture, the os, although considerably dilated, may retract until the head at length descends and again dilates it. After the obstruction at the superior strait is passed—where, of course, it is greatest—the head usually descends the remainder of the birth-canal with ease and rapidity, but labor may be prolonged by an exhaustion of the natural forces in the attempt to secure engagement. The apparent anomalies in the mechanism of labor characteristic of this deformed pelvis are in reality the best possible provision for the spontaneous obviation of the obstruction. The transverse position of the head at the inlet, the increased lateral inclination, and the imperfect flexion are designed to accommodate the size and the shape of the head to the unnatural size and shape of the pelvic inlet. An explanation of these peculiarities in the engagement of the head can be found in the altered relation of expulsive and resistant forces. The head, forced down upon the flattened brim and free to move upon the neck, rotates until its longest diameter is adjusted to the greatest diameter of the inlet—the transverse. It seeks the direction of least resistance, as any inert body will when propelled through a contracted canal. But the transverse position of the head alone is not sufficient to overcome the obstruction. The biparietal diameter of the head is too large to enter the conjugate of the pelvis. The occiput, the bulkiest portion of the skull, seeks the greater space to one side of the promontory, and is pushed against the lateral brim of the pelvis, the ilio-pectineal line. Here it is arrested. Further propulsion of the head is secured by a movement of partial extension, which brings rather the small bitemporal than the larger biparietal diameter of the head in relation with the contracted conjugate. Still, the obstruction may not be overcome. Both sides of the head may be unable to enter the pelvis at once. One side is propelled into the pelvic canal, the other is held back. That side which encounters the most resistance will naturally be the last to enter. Thus it is that usually the anterior parietal bone, slipping more easily past the symphysis, enters first. To this result also the inclination of the pelvic axis to the axis of the trunk contributes. Owing to the anterior position of the whole sacrum and to the diminished antero-posterior diameter of the pelvic outlet, on account, also, of the transverse position of the head and of its imperfect flexion, rotation of the head on the floor of the pelvis occurs late, and occasionally fails altogether, the head being expelled from the vulva in its original transverse or in an oblique position.

The localized pressure to which the maternal structures are subjected results sometimes in necrosis of cervical tissue over the promontory and of the anterior vaginal wall behind the symphysis. On the child's head the caput succedaneum is not exaggerated, because the head, when once firmly

engaged in the pelvis, descends the birth-canal rapidly, but there is apt to be a depression on that portion of the skull applied to the promontory—namely, on the posterior parietal bone between the greater fontanelle and the parietal emi-



FIG. 314.—Depression in the parietal bone caused by the pressure of the promontory (Winkel).

nence, usually quite close to the sagittal suture (Fig. 314). Sometimes a succession of these depressions or a gutter-shaped groove may be noted in a line running outward and forward on the child's skull. More frequently the course of

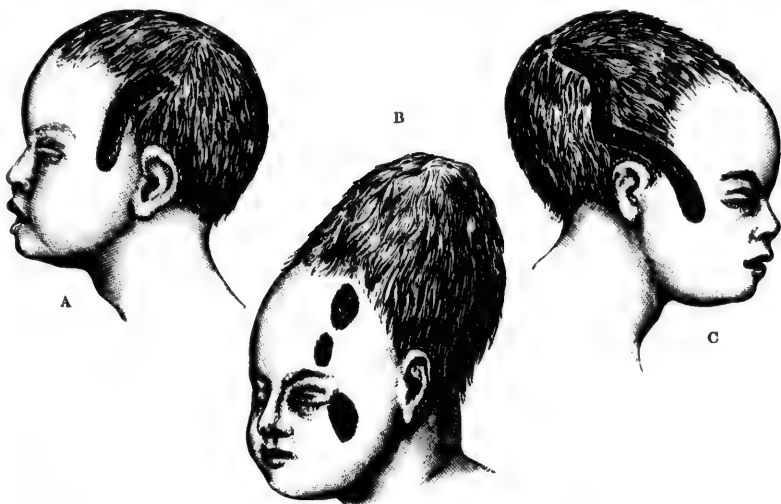


FIG. 315.—Marks made by the promontory on the child's head and face (Fritsch and Küstner).

the head and face over the promontory is marked by a red streak running from the depression before noted in a line parallel with the coronal suture toward the temple if the head is well flexed after engagement, or to the outer corner of the posterior eye, or, in case of extreme flexion, to the cheek (Fig. 315, A, B, C).

Usually the posterior parietal bone is depressed below the anterior, which overlaps it at the sagittal suture. The posterior side of the skull is also flattened from the greater and more prolonged pressure to which it is subjected. Ordinarily the lateral inclination of the child's head is in a direction from before backward, so that the anterior parietal bone presents at the centre of the superior strait. Occasionally this inclination is so exaggerated that the ear is the presenting part. Exceptionally the lateral inclination takes the opposite direction, the anterior parietal bone catches on the rim of the pubic bones, and the posterior parietal bone is the first portion of the child's head to enter the pelvis. The presentation of the posterior fontanelle occurs even in normal pelves as a rare exception, but is seen in about 10 per cent. of contracted pelves (Schauta), and is the result in them very likely of firm abdominal walls and an increased inclination of the pelvic inlet to the axis of the trunk. In these cases the anterior parietal bone is pushed under the posterior at the sagittal suture. When the posterior side of the head by descent finds room in the hollow of the sacrum and moves backward, the anterior portion of the skull glides over the symphysis, and the sagittal suture moves from its original position, just behind the symphysis, toward the median line of the pelvic canal. In addition to these anomalies of mechanism, Breisky describes what he calls an "extra-median" engagement of the head in cases of flat pelvis in which there is considerable lordosis of the lumbar vertebrae. The head in extreme flexion is forced down upon half of the pelvic inlet, and enters the pelvic canal on this side alone. Directly the obstructing promontory and lumbar vertebra are passed the head descends the pelvic canal with rapidity and ease. This mechanism was noted nineteen times in Breisky's clinic among 2002 labors.⁷

Justo-minor Pelvis.—In this type of contracted pelvis the form of the female pelvis is preserved, but the size is diminished (Pl. 29, Fig. 1). Three divisions of this pelvis are commonly made: The *juvenile*, in which the bones are small and slender; the *masculine*, in which the bones are large, heavy, and thick; and the *dwarf*, or *pelvis nana*, in which the pelvis is very diminutive in size and the pelvic bones are not joined by bony union, but are separated by cartilage as in the infant. The innominate bones are divided into their three parts, and the sacral vertebrae are distinct from one another (Pl. 29, Fig. 2). The justo-minor pelves pass by insensible gradations into the simple flat, the transversely-contracted, and the generally-contracted flat pelves. In the larger cities of the United States the justo-minor pelvis is very frequently encountered. It is certainly as common here as is the simple flat pelvis, and if one were to judge from hospital patients, among whom there is a large proportion of shop- and factory-girls, this variety of contracted pelvis would be regarded as the commonest.

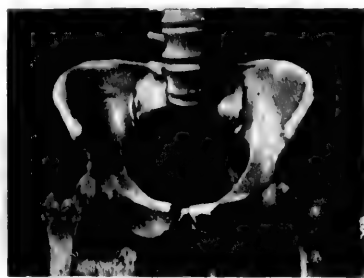
Characteristics.—While it is convenient to speak of the justo-minor pelvis as the normal female pelvis in miniature, the description is not strictly accurate. There are peculiarities due to an arrest of development which give to the equally generally-contracted pelvis some of the features of an infantile pelvis. The alae of the sacrum are narrower than they should be in compari-



C. v. 9½ cm. 1 Obl. 10½ cm.
Tr. 11 cm.



2



C. v. 9½ cm. 3 Obl. 11¼ cm.
Tr. 12½ cm.



C. v. 10½ cm. 4 Tr. (outlet) 7 cm.
Tr. (inlet) 8½ cm. Ant. post. outlet 7½ cm.



5



6



7



8

1. Justo-minor pelvis (Mütter Museum, College of Physicians, Philadelphia), inlet a perfectly symmetrical ovoid. 2. Dwarf pelvis. 3. Justo-minor pelvis with ruptured pelvic joints, following forceps application (Hirst Collection, University of Pennsylvania). 4. Narrow, funnel-shaped pelvis (specimen in the Hirst Collection, University of Pennsylvania). 5. Fetal ill-developed pelvis, probably an arrested development from rachitis (Mütter Museum, College of Physicians). 6. Minor grade of narrow, funnel-shaped pelvis with contracted pubic arch. 7. Obliquely-contracted pelvis (Saegele). 8. Obliquely-contracted pelvis (photographed from a plaster cast).



son with the bodies of the vertebræ. The sacrum is short and is not pushed as far forward between the iliac bones as it usually is; it shows also a diminished forward inclination, and on its anterior surface a greater lateral, and a less marked perpendicular, concavity than common. The distance between the posterior superior spinous processes of the iliac bones is relatively great, on account of the posterior position of the sacrum and its slight rotation forward. The conjugato-symphyseal angle is greater than normal, by reason of the lessened inclination outward of the symphysis and the pubic bones. The promontory is high and not prominent, and the inclination of the pelvic entrance to the abdominal axis as the individual stands erect makes a more obtuse angle than it does in the normal pelvis. The bones in this form of contracted pelvis are commonly small and slender, except in that somewhat unusual variety the masculine pelvis, in which they are firm and thick beyond the normal. Women with a justo-minor pelvis are ordinarily of slight build and below the medium height; but this pelvis may be found in individuals of ordinary stature, and sometimes actually in tall women of large frame.

The true dwarf pelvis (Pl. 29, Fig. 2) is very rare. It is found only in women of dwarf stature. The bones are slender and fragile, and the cartilaginous junction between the original divisions of the pelvic bones is preserved. There is extreme contraction of the pelvic canal.

In the commoner kinds of justo-minor pelvis the contraction is not often very great. The conjugate diameter is seldom below 9, and scarcely ever so low as 8, centimeters. The pelvic outlet in some cases is laterally contracted; in others it is comparatively roomy.

Etiology.—The justo-minor pelvis is the result of arrested development; it may be found in women descended from a stock that has deteriorated physically, or in women subjected during childhood, infancy, or intra-uterine existence to unfavorable hygienic surroundings or conditions.

Diagnosis.—The justo-minor pelvis is easily confused with a rachitic pelvis, but the distinction is readily made by careful pelvimetry. All the measurements, while equally reduced, bear their normal proportion to one another, except in the case of the external conjugate diameter, which is apt to be longer than would be expected, on account of the posterior position of the sacrum and its lessened inclination forward. In estimating the true conjugate diameter from the diagonal conjugate one must take account often of the increase in the conjugato-symphyseal angle, and must remember that the sum to be subtracted from the diagonal conjugate is not infrequently greater than common. The symphysis is less in height than in the normal pelvis, but the error of computation from this source may be disregarded. Löhlein lays special stress upon the importance of measuring the pelvic circumference in making the diagnosis of this form of contracted pelvis. It is always far below the normal, 90 centimeters. An internal examination of the pelvic cavity and inlet should be made carefully, to determine approximately their capacity, with a special regard to the approximate length of the transverse diameters.

Influence on Labor.—The mechanism of labor shows far fewer anomalies

in this than in any of the other forms of contracted pelvis. The head, from the greater resistance encountered, is strongly flexed. It may be placed transversely, but is quite commonly oblique, and may even be antero-posterior in position if there is a tendency to lateral contraction of the pelvic canal. By the perfect flexion of the head the obstruction to the progress of labor is in great part obviated. If anything interferes with this movement of the head, as a faulty application of the forceps, engagement and descent may become impossible. Pelvic presentations in labor are a great disadvantage by reason of the difficulty experienced in freeing the arms and in bringing the head last through the generally-contracted pelvic canal. To secure its rapid passage, the child's head must be flexed strongly by the operator's finger in its mouth before an attempt is made to secure engagement in the superior strait. While the woman escapes localized necroses of the soft tissues following labor in the justo-minor pelvis, there is greater likelihood of rupturing pelvic joints in this than in any other variety of contracted pelvis, and there is also an extraordinary liability to eclampsia (Pl. 29, Fig. 3). The caput succedaneum, which is very large on account of the early fixation of the head and the long labor, is situated directly over the smaller fontanelle. There is an overlapping of the cranial bones both laterally and antero-posteriorly.

The generally-contracted, flat, non-rachitic pelvis presents the combined features of the flat and the generally-contracted pelvis.

Characteristics.—All the diameters are below normal, but the conjugate is less in proportion than any of the others. This pelvis has many of the features of a rachitic pelvis, but the anterior half of the pelvic circumference is not markedly broadened; indeed, it is often the reverse. The sacrum is small and is not rotated on its transverse axis; it is placed farther back between the innominate bones than in the normal pelvis, and very much farther back than in the rachitic pelvis. The promontory is high and is not prominent. The influence of this deformity of the pelvis upon labor is that of a flat pelvis, but the difficulties are greater than in the case of the simple flat pelvis, for there is less compensatory room in a transverse direction. The generally-contracted non-rachitic flat pelvis is comparatively rare. The flattening, according to Litzmann, is due to a shortening of the innominate bones, especially at the ilio-pectineal line. In estimating the true conjugate diameter of the generally-contracted flat pelvis it is safer to subtract 2 instead of $1\frac{1}{4}$ centimeters from the diagonal conjugate, on account of an increase in the conjugato-symphyseal angle, the result of the high position of the promontory and the diminished slant outward of the symphysis.

Etiology.—This generally-contracted type of pelvis is due to hereditary influence or to an arrest of development in the embryo, fetus, or infant. It is claimed, however, that it may be produced by premature attempts to walk and by long standing upon the feet in very early life.

Diagnosis.—The recognition of a generally-contracted flat pelvis is difficult. The measurements usually resemble those of a generally equally-contracted pelvis, but the conjugate diameter is less than one expects in that form

of contracted pelvis, and the mechanism of labor is that of a flat pelvis. The diagnosis can be made by finding the reduced conjugate diameter and by the ease with which one can reach the lateral pelvic wall in the palpation of the interior of the pelvic canal. A certainty of diagnosis can be obtained during life only by the direct measurement, not only of the conjugate diameter, but also of the transverse, by the methods of Löhlein and of Skutsch.

The Narrow, Funnel-shaped Pelvis; Fetal or Undeveloped Pelvis.—

This variety of pelvis is contracted transversely at the pelvic outlet, or both in the transverse and antero-posterior diameters, without abnormalities in the spinal column. The depth of the pelvic canal is much increased by the length of the sacrum, of the symphysis, and of the lateral pelvic walls. The sacrum is narrow, has little perpendicular curve, and is placed far back between the ilia (Pl. 29, Figs. 4, 5). Schauta ascribes this form of contraction to an anomaly of development by which the pelvic walls are lengthened downward and the weight of the body is thrown backward upon the sacrum. It is said to be very rare, but it has been found quite frequently in those hospitals where the outlet of the pelvis is regularly measured. It comprises from 5 to 9 per cent. of all contracted pelves, according to Breisky, and Fleischmann found twenty-four examples in 2700 parturient women.⁸ A slight manifestation of the deformity is often called a "masculine" pelvis by reason of the diminution in the breadth of the pubic arch. This degree of the funnel-shaped pelvis is frequently encountered (Pl. 29, Fig. 6).

Diagnosis.—The diagnosis of a narrow, funnel-shaped pelvis is made by a comparison of the measurements of the pelvic inlet with those of the outlet. The former are found to be normal or even greater than normal, while the measurements of the outlet are diminished. If, as is the rule in extreme degrees of this deformity, the inlet and cavity are contracted, the outlet is still smaller in proportion. A careful palpation of the pelvic canal is an important aid to a correct diagnosis. The pelvic walls are felt to converge as they approach the outlet; the narrowness of the pelvic arch is appreciated, and the approximation of the tuberosities and spines of the ischial bones is noticeable.

Influence upon Labor.—The peculiarities of mechanism in labor are malpositions of the head at the outlet (as backward rotation of the occiput), oblique and transverse position of the head, and imperfect flexion. There is also an insufficiency of the expulsive forces, the greater part of the fetal body being contained in the lower uterine segment, cervix, and vagina, while the upper muscular segment of the uterus is in great part emptied and therefore powerless. By the approximation of the pubic rami the presenting part is forced backward, and serious lacerations of the perineum are to be feared. The pressure of the head upon the lower birth-canal may result in necrosis of soft structures or lacerations along the descending rami of the pubis and the ascending branches of the ischium. The tissues over the projecting spines of the ischial bones are also the seat of tears or of necroses. The narrowing of the pubic arch may lead to serious injuries if the forceps be applied. The writer has seen long clean cuts in the anterior vaginal walls, and profuse hem-

orrhage, following the use of instruments. In well-marked examples of the narrow, funnel-shaped pelvis, with a transverse diameter at the outlet not much below 3 inches, symphysiotomy gives the best chance of a successful termination for mother and child. Higher grades of contraction with a diameter of 2 inches and under demand Cesarean section. In lesser grades the woman may be delivered spontaneously or by forceps.

Obliquely-contracted Pelvis from Imperfect Development of the Ala on one Side of the Sacrum (Naegele Pelvis).—This pelvis was first described in 1834 by Franz Carl Naegele,⁹ but had been noticed as early as 1779 without a full understanding of its significance (Pl. 29, Figs. 7, 8).

Characteristics.—The pelvic inlet has an oval shape, with the small point of the oval directed to the atrophied side of the sacrum. The sacral ala is atrophied or is absent, not only in that portion of the bone entering the sacro-iliac joint, but also in the transverse process along its whole length. The sacro-iliac joint on this side is ankylosed in the vast majority of cases, but not invariably. The sacrum is narrow, asymmetrical, and turned with its anterior face toward the deformed side of the pelvis. The promontory is not only turned in this direction, but is also pulled over to the diseased side. The innominate bone on this side is pushed as a whole upward, backward, and inward, and its anterior face is pushed inward and backward. The tuberosity of the ischium, as a necessary consequence of the displacement of the innominate bone, is higher than its fellow, projects into the pelvic canal, and is so turned that it looks rather antero-posteriorly than laterally. The spine of the ischium is brought quite close to the corresponding edge of the sacral bone and juts prominently forward into the pelvic canal. The whole innominate bone on the diseased side lacks its normal curvature at the ilio-pectineal line, and may run almost straight from the sacro-iliac junction to the symphysis pubis. The opposite innominate bone has a greater curvature than common, especially in its anterior half; otherwise it is practically normal in structure, position, and inclination. The symphysis pubis is pushed toward the healthy side of the pelvis, and its outer surface, instead of looking directly forward, is inclined to the diseased side. The pubic arch likewise faces somewhat in this direction; its aperture is asymmetrical and irregularly contracted, as the ischiae and pubic rami on the diseased side are pushed inward upon the pelvic canal and over toward the healthy side (Pl. 29, Figs. 7, 8).

Etiology.—The cause of the obliquely-contracted pelvis under description is an absence of the bony nuclei in the ala or lateral process on one side of the sacrum. The lateral process consequently fails to develop, and the innominate bone is brought in relation with the bodies of the sacral vertebrae. As a result there must be some distortion of the innominate bone even in fetal and infantile life, but this is increased to an exaggerated degree when the individual begins to walk. Instead of receiving the pressure from the lower extremity approximately on the keystone of an arch, as does a normally-curved innominate bone, the deformed bone in a Naegele pelvis transmits the pressure in almost a straight line upward and backward, so that the extremity

of the posterior arm of the arch slides past the sacro-iliac joint instead of resting firmly on it as an arch does on its abutments. The irritation and strain of this unnatural movement bring about in time the atrophy and ankylosis of the joint.

That the deformity in this kind of oblique pelvis does not follow a primary ankylosis of the sacro-iliac joint is proven by the fact that the innominate bone is pushed backward and upward on the sacrum—a movement that would be impossible were this joint first ankylosed. As a further proof of primary lack of development and secondary ankylosis, there is no trace of inflammation in or about the ankylosed joint, and the alæ or transverse processes of the sacrum are atrophied or are absent along the whole length of the sacrum, and not only in that portion of it which enters into the composition of the sacro-iliac joint.

Diagnosis.—The recognition of an obliquely-contracted pelvis from arrested development of the sacral alæ may be very difficult. There is nothing to direct the attention of the physician to the possibility of this deformity. There is no history of previous disease or of accident, no scar of an old fistula over the joint, and the patient does not limp. The diagnosis can be made only by a methodical external and internal palpation of the pelvis and by careful measurements. If the outspread hands are laid over the innominate bones, it will be noticed that the dorsal surfaces are directed obliquely forward and backward as they lie upon the diseased and healthy sides. An internal palpation of the pelvis will detect one lateral wall much nearer the median line than the other, and the diagonal conjugate will be found to run not antero-posteriorly in direction, but from before backward and from the healthy to the diseased side of the pelvis. There are a number of points from which measurements may be taken that will show inequalities where in the normal pelvis the distances should be the same or should differ by a very small sum. Naegele recommended the following measurements: (1) The distance of the tuber ischii on one side from the posterior superior spinous process of the ilium on the other; (2) from the anterior superior spinous process of one ilium to the posterior superior spinous process of the other; (3) from the spinous process of the last lumbar vertebrae to the anterior superior spines of both ilia; (4) from the trochanter major of one side to the posterior superior spinous process of the opposite iliac bone; (5) from the lower edge of the symphysis pubis to the posterior superior spinous processes of the iliac bones. In addition to these measurements, others of value have been suggested by Michaelis and by Ritgen. These are the distances from the middle line of the spinal column to the posterior superior spinous processes of the iliac bones, and the distance from the lower edge of the symphysis to the ischial spines, and from these spines to the nearest point on the edges of the sacrum. In this latter measurement it will be found that the distance from the symphysis to the ischial spine is longest on the diseased and shortest on the healthy side, while the distance from the ischial spine to the edge of the sacrum is very much shorter on the diseased than on the healthy side. This last, which is a very important meas-

urement, can easily be taken by laying finger-breadths between the points to be measured.

Influence on Labor.—The mechanism of labor in an obliquely-contracted pelvis is in the main that of labor in a generally-contracted pelvis. The shape of the pelvic entrance and canal is symmetrically ovoid, and the head can enter the contracted space only by extreme flexion. There are none of those anomalies of position, flexion, and inclination of the head which are seen in the flat pelvis. As the head descends the birth-canal anomalies of mechanism may appear resembling those described in the narrow, funnel-shaped pelvis—namely, abnormal and imperfect rotation and anomalies of flexion. Depending upon the degree of deformity, there is more or less interference with the progress of labor to complete obstruction. The head can almost invariably be found entering the pelvis and passing through the canal with its longest diameter in coincidence with the longest oblique diameter of the pelvis, from the diseased sacro-iliac joint to the opposite ilio-pectineal eminence.

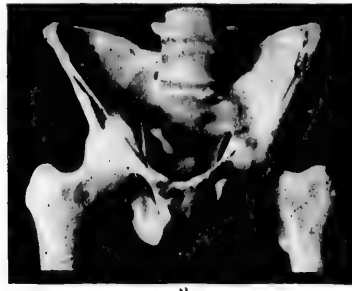
Prognosis.—In the recorded cases the results of labor in the Naegele pelvis have been bad. Of 28 women reported by Litzmann, twenty-two died in their first labor, five of them undelivered. Three of these women died in consequence of their second labor, and two after the sixth. Out of 41 cases, six were delivered spontaneously, twelve by the forceps, fourteen by craniotomy, five by version and extraction, four by premature labor, and two by Cesarean section. The following accidents were noted in the course of labor or shortly afterward: Rupture of the uterus or vagina, vesico-vaginal fistula, fracture of the horizontal ramus of the pubis, rupture of the sacro-iliac joint and of the symphysis. In another series of cases, 28 women furnished 42 labors with the following results: twenty-one died as the result of the first labor, three of the second, and one after the sixth. These women were delivered seven times by craniotomy, once by Cesarean section, four times by premature labor, and in a number of instances by forceps. Out of 41 children in Litzmann's statistics there were only ten delivered alive, two of these by Cesarean section and two by premature labor. The six other living children were all born of the same mother.*

Treatment.—Forceps and version are not, as a rule, successful in the treatment of labor obstructed by an obliquely-contracted pelvis unless the degree of deformity is slight. The induction of premature labor and the performance of Cesarean section are the most successful means of delivery, but the former should be resorted to only when the distance between the lower edge of the symphysis pubis and the sacro-iliac joint of the healthy side is not under 8.5 centimeters. In 20 forceps operations thirteen women died. The proposition of Pinard to do what he calls ischio-pubiotomy will not meet with much favor. The room gained by the movement outward of the innominate bone on the healthy side, the other being, of course, immovable, will be sufficient only in pelvis so slightly contracted as to allow a delivery perhaps by much simpler means.

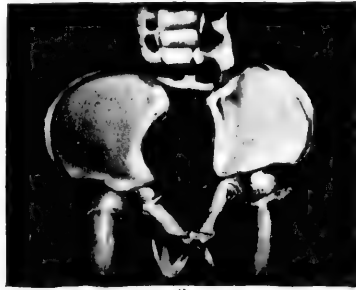
* The writer is indebted for these statistics to Schauta (*loc. cit.*).



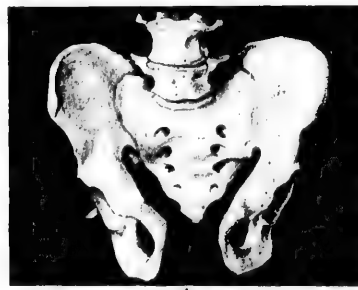
C. v. 9½ cm. 1 Tr. (outlet) 5 cm.
T. (inlet) 8 cm.



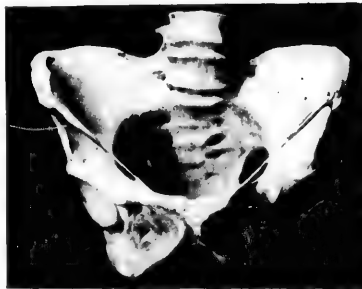
2



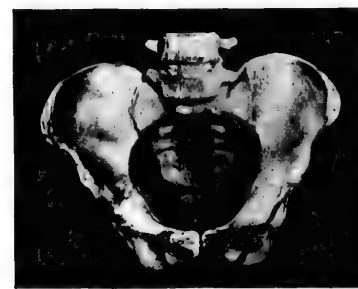
3



4



5



6



C. v. 5½ cm. 7
Ell. tr. diam 11 cm.



C. v. 4 cm. 8

1. Transversely-contracted pelvis (Robert; model in Mütter Museum, College of Physicians, Philadelphia).
2. Transversely-contracted pelvis, showing contraction at outlet (model in the Hirst Collection, University of Pennsylvania).
3. Transversely-contracted pelvis, with absence of sacrum (Hohl).
4. Split pelvis (Schauta).
5. Generally equally-contracted rachitic pelvis (Hirst Collection, University of Pennsylvania).
6. Generally contracted rachitic pelvis (Hirst Collection, University of Pennsylvania).
7. Typical flat rachitic pelvis (Mütter Museum, College of Physicians). The promontory of the sacrum projects so far forward that the true transverse diameter is bisected by it.
8. Flat rachitic pelvis, with unusual descent of the promontory, rotation of the sacrum, and lordosis (Mütter Museum, College of Physicians).



Transversely-contracted Pelvis the Result of Imperfect Development of both Sacral Alæ.—This pelvis was first described in 1842 by Robert, and is generally known as the "Robert pelvis" (Pl. 30, Figs. 1, 2). It is the rarest of all contracted pelves. Schauta was able to find but six examples recorded in childbearing women. Ferruta has recently reported another case.¹⁰ Herman gives eight as the number of recorded cases. The anatomical conditions are the same as in the Naegele pelvis, except that both sides of the sacrum are affected instead of one. Other parts of the sacrum besides the alæ may show imperfect development. There is a case reported in which the whole lower portion of the bone was absent (Pl. 30, Fig. 3). The sacrum in this pelvis is extremely narrow, and the posterior superior spinous processes of the iliac bones are brought close together. The degree of contraction in the transverse diameter is so extreme that natural labor is out of the question. An asymmetry of the Robert pelvis has been observed, one side showing a greater degree of the deformity than the other, and thus approaching the type of an obliquely-contracted pelvis.

The *cause* of this deformity is an absence of the bony nuclei in the sacral alæ of both sides. Secondly, as in the Naegele pelvis, there is apt to be an ankylosis of the sacro-iliac joints. That this ankylosis is secondary and not primary is demonstrated by the same condition which proves that ankylosis is not a primary cause of the oblique contraction and ill-development of one side in the Naegele pelvis—namely, a displacement of the ilia on the sacrum necessarily occurring before the ankylosis.

The *treatment* of labor obstructed by a transversely-contracted pelvis of this kind simply resolves itself into the performance of Cesarean section.

Justo-major Pelvis.—A generally equally-enlarged pelvis may be found in women of gigantic stature, but it may also be demonstrated in a woman of medium height. The pelvis of the Nova Scotian giantess was large enough to give passage to a child weighing 28½ pounds. The largest pelvis that has ever come under the writer's notice was found in a woman somewhat below the average height, without an abnormally great development of any other portion of her frame.

Diagnosis.—The diagnosis of a justo-major pelvis is made mainly by external measurements. If all of them are found far in excess of the normal while preserving their normal relative proportion, the diagnosis of a justo-major pelvis is justifiable. The internal examination, if considered necessary, will show that the promontory is quite inaccessible, and that it is much more difficult than common to reach the lateral pelvic walls. This anomaly of the pelvis does not, of course, obstruct labor; on the contrary, it predisposes to precipitate delivery, although the resistance of the soft parts may be quite sufficient to delay the process considerably, even though the pelvis present no obstacle whatever. During pregnancy it is noted that the uterus has a tendency to sink deep within the pelvic canal, so that pressure-symptoms of the pelvic viscera and blood-vessels are common in the latter weeks of gestation, and these symptoms may become so exaggerated as to make locomotion diffi-

cult. In labor there may be noted anomalies in the mechanism dependent upon insufficient resistance to the engagement of the head. Thus imperfect flexion at the superior strait may be observed, and there may be a tardy rotation of the head on the pelvic floor.

Split Pelvis.—The split pelvis, which is due to a defect in the development of the lower portion of the trunk in front, is almost invariably associated with exstrophy of the bladder. This pelvis has very rarely been observed in the childbearing woman; there are on record but seven examples complicating labor. This form of pelvis presents no obstacle in parturition. There are the same peculiarities in labor as in the justo-major pelvis—namely, a tendency to precipitate birth, and anomalies in the mechanism the result of imperfect resistance. After labor it is almost certain that there will be a prolapse of the uterus. The *diagnosis* of this deformity presents no difficulties, and no obstetric treatment is called for in labor (Pl. 30, Fig. 4).

The Rachitic Pelvis.—In the healthy life and growth of bones two opposed processes are found: on the periphery there is an active proliferation of cells to form the bone-structure, while in the interior, bone-substance is being constantly absorbed by the marrow. In rachitis the absorption of bone-substance goes on more rapidly than it does in healthy bone, and at the same time there is in the periphery a very much more rapid proliferation of cells, which do not, however, develop normal bone-structure. Their growth and multiplication result in the formation of an osteoid material poor in lime-salts and much more pliable than healthy bone. The result of this pathological process in the pelvic bones is to make the pelvis more sensitive than it should be to the mechanical forces that are brought to bear upon it.

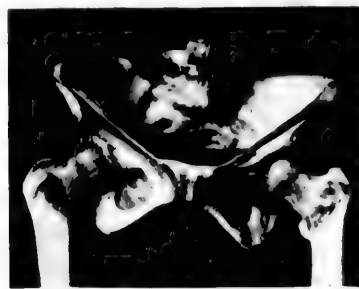
In the rachitic pelvis the size and shape of the pelvic canal are modified by three factors: the pressure from the trunk above and the counter-pressure from the extremities below; the pull on the pelvic bones by ligaments and muscles; and an arrested development the consequence of an interference with normal growth that this disease occasions.

Characteristics.—The effect upon the shape and size of the pelvic canal of rachitis in the pelvic bones is not uniform. Several varieties of contracted pelvis may result. The commonest is the flat pelvis with some contraction of all the diameters, but a most marked diminution in the antero-posterior diameter (Pl. 30, Fig. 7). There may, in addition to this common form, be found a simple flat rachitic pelvis without alteration of the transverse diameters, a generally equally-contracted rachitic pelvis (Pl. 30, Figs. 5, 6), and a so-called "pseudo-osteomalacic" pelvis, in which the effect seen in osteomalacia is produced by pressure upon the bones softened by rachitis. There are other rare forms of asymmetrical development, in connection usually with spinal disease of rachitic origin, that will be described elsewhere.

Characteristics of the Flat, Generally-contracted Rachitic Pelvis.—The sacrum is pressed forward and downward between the iliac bones, and is rotated on its transverse axis, mainly by the pressure of the trunk upon it, but partly by the pull downward of the psoas muscles upon the spinal column



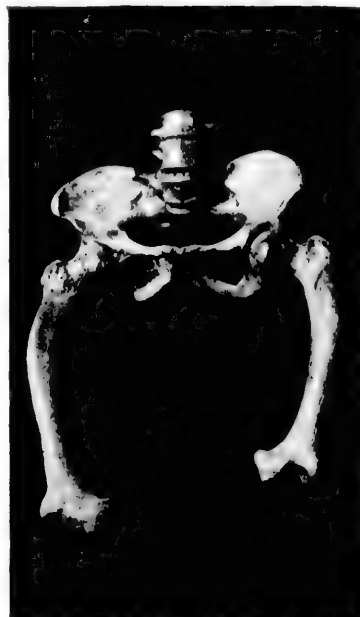
1



C. v. 7½ cm.

2

Tr. 11¼ cm.



C. v. 5 cm.

3

Tr. 12¼ cm.



C. v. 5 cm.

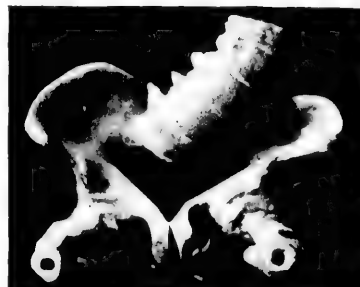
Tr. (inlet) 11 cm.

4

Tr. (outlet) 11¼ cm.



5



6



7

1. Flat rachitic pelvis, showing anterior position of acetabula (Mütter Museum, College of Physicians, Philadelphia). 2. Flat rachitic pelvis, showing relative measurements of antero-posterior and transverse diameters at inlet (Mütter Museum, College of Physicians). 3. Flat rachitic pelvis with bowed femora (Mütter Museum, College of Physicians). 4. Flat rachitic pelvis, showing relative measurements of inlet and outlet (Mütter Museum, College of Physicians). 5-7. Pseudo-osteomalacia.



and the pull upward upon the posterior surface of the sacrum by the erectores spinæ muscles (Pl. 30, Fig. 8). The effect of this movement would naturally be to throw the tip of the sacrum and the coccyx directly backward, so that the posterior surface of the sacral bone would run an almost horizontal course as the woman stood upon her feet. The attachments of the sacro-sciatic ligaments and muscles to the lower sacrum and coccyx, however, prevent this backward movement of the bone as a whole, and, pulling the lower portion of the bone forward, cause a sharp bend in it, usually at the junction of the fourth and fifth sacral vertebræ. The sacrum is narrowed in its transverse diameter, and the lateral concavity of the anterior surface is effaced, by the forward movement of the bodies of the vertebræ between the alæ. The anterior surface of the sacrum, indeed, may be convex from side to side. By the pull of the strong sacro-iliac ligaments running from the sacrum to the posterior superior spinous processes of the iliac bones the latter are pulled downward and forward by the descent of the sacral promontory, and are consequently made to approach one another behind, but they do not keep pace with the movements of the sacrum, and consequently project more prominently than common on either side. The natural result of this movement forward and inward on the part of the posterior superior portions of the ilia would be to throw the anterior half of the innominate bones outward, but this movement is opposed by their junction at the symphysis, and to a less degree by the attachment of Poupart's ligament to their anterior superior spinous processes. The ilia, however, restrained by a somewhat yielding force, are thrown to a certain degree outward and backward, so that their upper edges run almost horizontally outward, and the distance between their anterior spines becomes little less than, the same as, or even greater than, the distance between their crests (Pl. 30, Fig. 7). A further result of these combined forces pulling the innominate bones inward and forward behind and holding them in place in front is to produce in them an abnormal curvature, as in the case of the sacrum, or as in a bow bent between one's hand and the ground (Pl. 31, Figs. 3, 4). The point of angulation or greatest curvature is found on the ilio-pectineal line, back of the median transverse line of the pelvic inlet, near the sacro-iliac joints. On account of the flexion of the innominate bones the transverse diameter of the rachitic pelvis is relatively increased, but as the whole pelvis is commonly below the normal in size, this diameter rarely exceeds, if, indeed, it equals, the normal transverse measurement. A further consequence of the exaggerated curvature of the innominate bones is to throw the acetabula forward, so that the counter-pressure of the lower extremities is exerted more antero-posteriorly than in the normal pelvis (Pl. 31, Fig. 1). The pubic rami and the symphysis are diminished in height and show a lessened slant outward. The cartilage at the junction of the symphysis projects inward upon the pelvic canal, standing out above the level of the bones to such a degree that it is sometimes a source of injury to the head or to the maternal structures. The force of resistance at the symphyses to the outward movement of the innominate bones sometimes bends the ends of the

pubic bones inward upon the pelvic canal, giving to the pelvic inlet the shape of a figure 8. From the traction of the adductor and rotator muscles of the thigh upon the tuberosities of the ischial bones (increased in rachitis by the positions of the acetabula and the bowing of the femora), the latter are pulled outward and forward so that the pubic arch is greatly widened and the transverse diameter of the pelvic outlet is increased (Pl. 31, Fig. 4). The antero-posterior diameter of the outlet is somewhat diminished by the excessive perpendicular curvature of the sacrum, but the contraction is relatively much less than in the conjugate of the inlet. The whole pelvis is tilted forward on its transverse axis, so that the inclination of the superior strait is increased and the external genitalia are displaced backward.

The bones of a rachitic pelvis are usually slighter and more brittle than common. They may, perhaps, show no peculiarities in structure, or in rare cases they may be found much thicker and heavier than normal.

In the generally equally-contracted rachitic pelvis—a rare type—is seen mainly an arrest of development, the consequence of rachitis in very early life, which retarded growth without much affecting the shape of the pelvic inlet and canal, from the fact that the pelvis had not been subjected to the pressure of the trunk during the active stage of the disease, because it ran its course to complete recovery before the child attempted to sit up or to walk. Possibly also the disease in some of these cases is not severe and lasts but a short time. As the deformity is the result of arrested development, we find a transverse contraction as in the fetal ill-developed pelvis (Pl. 30, Figs. 5, 6).

The *diagnosis* of the rachitic origin of this type of pelvis is made by the relations of iliac spines to crests, by the history of rachitis in early infancy perhaps, and possibly by the signs of the disease in other portions of the body.

In the *pseudo-osteomalacic pelvis* the rachitis has been severe in character and long continued. Efforts to walk have been made while the disease was in active progress, and possibly the weight of the trunk has been exaggerated by attempts to carry heavy burdens. As a consequence of the pressure of the trunk and the counter-pressure of the lower extremities the pelvis bends to an extreme degree under the forces imposed upon it. The sacrum sinks far down into the pelvic canal and is sharply curved or bent from above downward; the innominate bones are bent at a sharp angle laterally, and the acetabula are pressed inward upon the pelvic canal. When at length the bone disease has run its course the pelvis is firmly set, by the hardening of the bones, in its unnatural position and shape. The differential diagnosis between this pelvis and the true osteomalacic pelvis is made by the direction of the iliac crests, by the firm constitution of the bones after the disease has been arrested, and by the signs of rachitis in other portions of the body. Osteomalacia, besides, has certain peculiarities of its own that enable one to recognize it without difficulty (Pl. 31, Figs. 5, 6, 7; Pl. 32, Fig. 1).

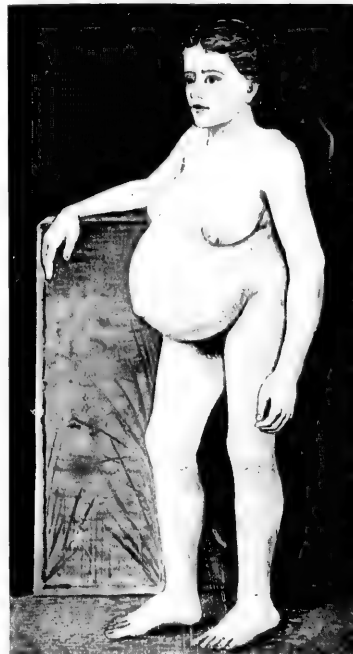
Diagnosis.—The diagnosis of a rachitic pelvis is made by external and internal measurements, by palpation of the exterior and interior of the pelvis, by the woman's history, and by her appearance. An individual who has had



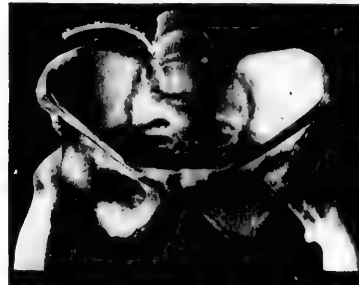
1



C. v. 8 cm. 2d sac. vert. to sym. 5 1/4 cm. 3d sac. vert. to sym. 4 1/4 cm. Tr. 11 1/4 cm.



3



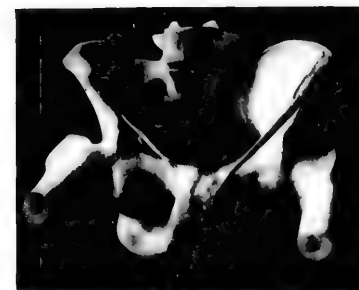
C. v. from 1st and from 2d sac. vert. 6 1/4 cm. Tr. 12 1/4 cm.



5



6



7

1. Pseudo-osteomalacia. 2. Rachitic pelvis with contracted antero-posterior diameter throughout the pelvic canal (Mütter Museum, College of Physicians, Philadelphia). 3. Pendulous belly of rachitis (Charpentier). 4. Rachitic pelvis with double promontory (Mütter Museum, College of Physicians). 5, 6. Minor grades of osteomalacic pelvis. 7. Osteomalacia, showing symmetrical contraction at outlet.



rachitis in childhood is usually of small stature, with short, thick, curved extremities, a low broad brow, a large square head, a flat nose, a "chicken breast," and enlarged joints. The lumbar lordosis and the rotation of the sacrum produce a sway-back, most noticeable when the woman lies on her back upon a hard surface. When she stands erect the pregnant uterus near term falls abnormally forward and downward, on account of the short abdomen and lack of engagement of the presenting part (Pl. 32, Fig. 3). The most characteristic facts in her history are that she walked first at three or four years of age and was late in getting her teeth. By the pelvimeter the normal relation between the iliac spines and crests is found disturbed. The difference in distances between the former and between the latter is much reduced. The posterior superior spinous processes are approximated, and the



FIG. 316.—Appearance during life of the highest grade of rachitis: pseudo-osteomalacia (Pippingkjöld).



FIG. 317.—Skeleton of a rachitic dwarf (Medical Museum, University of Pennsylvania).

depression under the last spinous process of the lumbar vertebra approaches or is actually in the line drawn between them. The external antero-posterior diameter of Baudelocque is below the normal. Internally, the diagonal conjugate is found considerably reduced. The symphysis has less of a slant outward than it should have, the promontory is found low and prominent, the sacral bone is sharply bent upon itself, and the pelvic canal is remarkably shallow. On account of the increase in the conjugate-symphyseal angle due to the lessened slant outward of the symphysis, at least 2 centimeters should be subtracted from the diagonal conjugate. The difference between the two would be greater were it not for the low situation of the promontory, which compensates to a certain extent for the lessened slant of the symphysis, but does not entirely neutralize it. A double promontory in these pelvises is not

uncommon (Pl. 32, Figs. 2, 4). If found, the measurement should be taken from the promontory nearest the symphysis. Occasionally the lordosis of the lumbar vertebræ, the result of spinal rachitis, is so great as to constitute itself an obstruction above the pelvic inlet. In such a case the effective conjugate must be taken from a point above the sacrum to the symphysis pubis (Pl. 30, Fig. 8).

Influence on Labor.—The influence on labor of a flat rachitic pelvis is much the same as the influence of a simple flat pelvis, except that the contraction, and consequently the obstruction to labor, is greater in the rachitic form, and that the promontory of the sacrum is more prominent and more sharply defined. The anomalies of mechanism at the inlet are the same in both forms of pelvis, but they are exaggerated in the flat rachitic pelvis. As soon as the obstruction at the inlet is overcome the descent of the head and its escape is more rapid in the rachitic pelvis, because of the shallow canal and the expanded

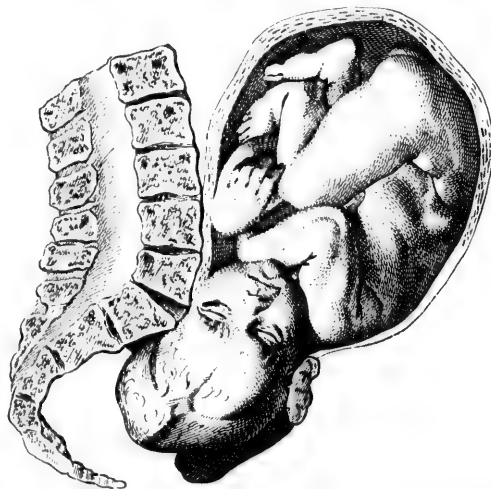


FIG. 318.—Pressure of the promontory upon the head in a contracted pelvis (Smellie).

outlet. Injuries to the child's head and to the maternal tissues from pressure are common. In the former a sharp indentation may be seen on that portion pressed against the promontory in the efforts to secure engagement (the so-called "spoon-shaped" depression, with fracture of the parietal bone; Figs. 314, 318, 319). Localized necroses are not infrequently seen in the maternal structures where they have been nipped between the child's head and prominent portions of the pelvic bones—namely, in the cervical tissues over the promontory, or very rarely in the posterior vaginal vault, and in the anterior vaginal wall behind the symphysis and the ridge of the pubic bones. When the slough separates openings may be established between the birth-canal and the peritoneal cavity, the bowel, the bladder, and a ureter.

Osteomalacic Pelvis.—Osteomalacia, a soft condition of the bones in consequence of an osteomyelitis and an osteitis, is exceedingly rare in

America. There are certain parts of the world where it is frequently seen, notably Italy, Germany, and Austria, but in America there are but three or four examples on record. The bones of the pelvis in this disease become so soft that they yield to every force imposed upon them. They bend before the pressure of the trunk from above, the extremities from below, and the pull of the muscles attached to the pelvic bones. The flexibility of the pelvis in extreme cases of osteomalacia can be appreciated when it is stated that the superior iliac spines may be bent backward until they touch the spinal column; the horizontal rami of the pubis may be pushed inward until they almost obliterate the pelvic inlet; and the tuberosities of the ischium may be approximated until they nearly close the pelvic outlet. Not only are the pelvic walls so compressed that they almost obliterate the pelvic canal, but the spinal column also, sinking under the weight of the trunk, bends far forward



FIG. 319.—Overlapping of the cranial bones in a futile attempt to engage in the superior strait of a rachitic pelvis (Smellie).

and descends low into the pelvis, occupying the little remaining room in the inlet and canal, and becoming itself a serious obstruction to the engagement of the presenting part. From the lateral pressure of the thigh-bones the ischia and pubes are pushed inward and backward, making by the former movement a sharp beak-like projection of the pelvic inlet between the pubic rami, and by the latter much diminishing the size of the pelvic canal (Pl. 32, Figs. 5, 6, 7). The sacrum is rotated on its transverse axis and is driven low into the pelvic canal—an exaggeration of the movement seen in a rachitic pelvis. The lower portion of the sacrum and the coccyx are pulled sharply forward by the muscles attached to them, so that the sacrum is bent at a sharp angle in its lower third. The innominate bones are bent laterally at a point slightly anterior to the sacro-iliac junction, and the iliac bones may be folded upon themselves horizontally. The inclination of the pelvis as a whole is much increased.

The *diagnosis* may be based upon the following symptoms: The disease begins usually during pregnancy or lactation, with dull aching pains in the extremities, the back, the lumbar region, and over the anterior portion of the pelvis. Every movement increases these pains. As the disease progresses the bones of the spinal column are so bent and compressed that the individual is diminished in stature to an extraordinary degree. She may lose as much as

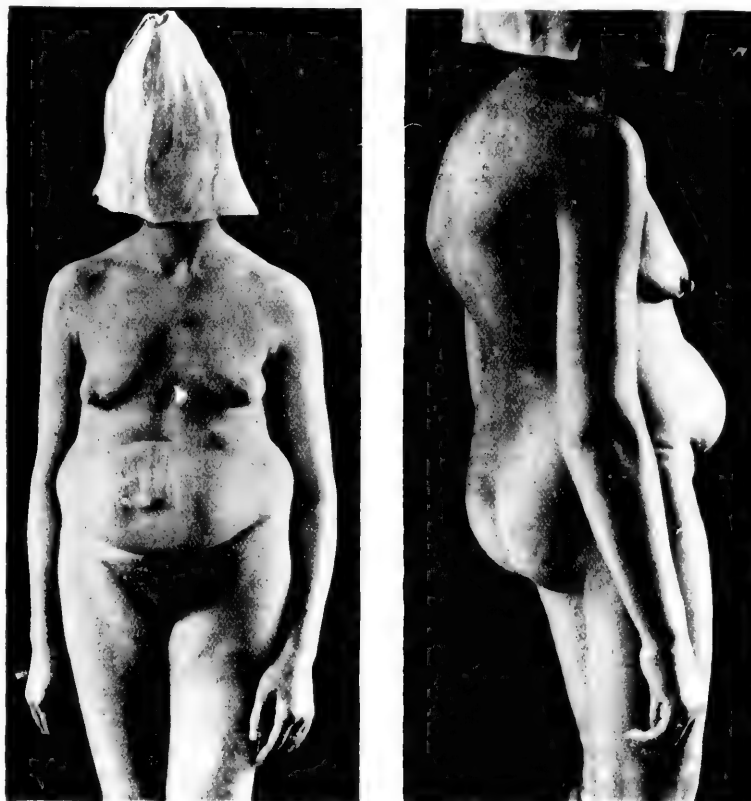
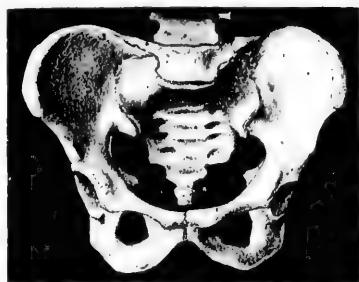
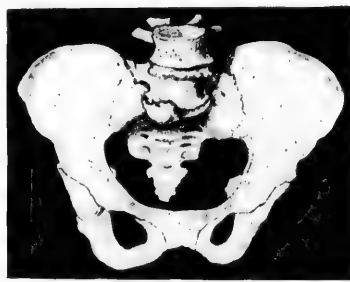


FIG. 320.—Hirst's case of osteomalacia (front and profile views in different perspective).

as much as four and a half in height (Fig. 320). The gait of an osteomalacic patient is peculiar. In order to compensate for the approximation of the thighs brought about by the collapse of the pelvis the individual must turn almost through a half circle in order to bring one foot in front of the other. Upon examination of the pelvis tenderness upon pressure is discovered over its anterior wall. The flexibility of the pelvic bones may be demonstrated by direct pressure, and an



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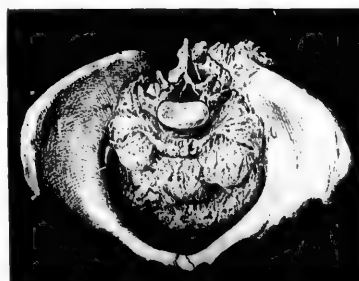
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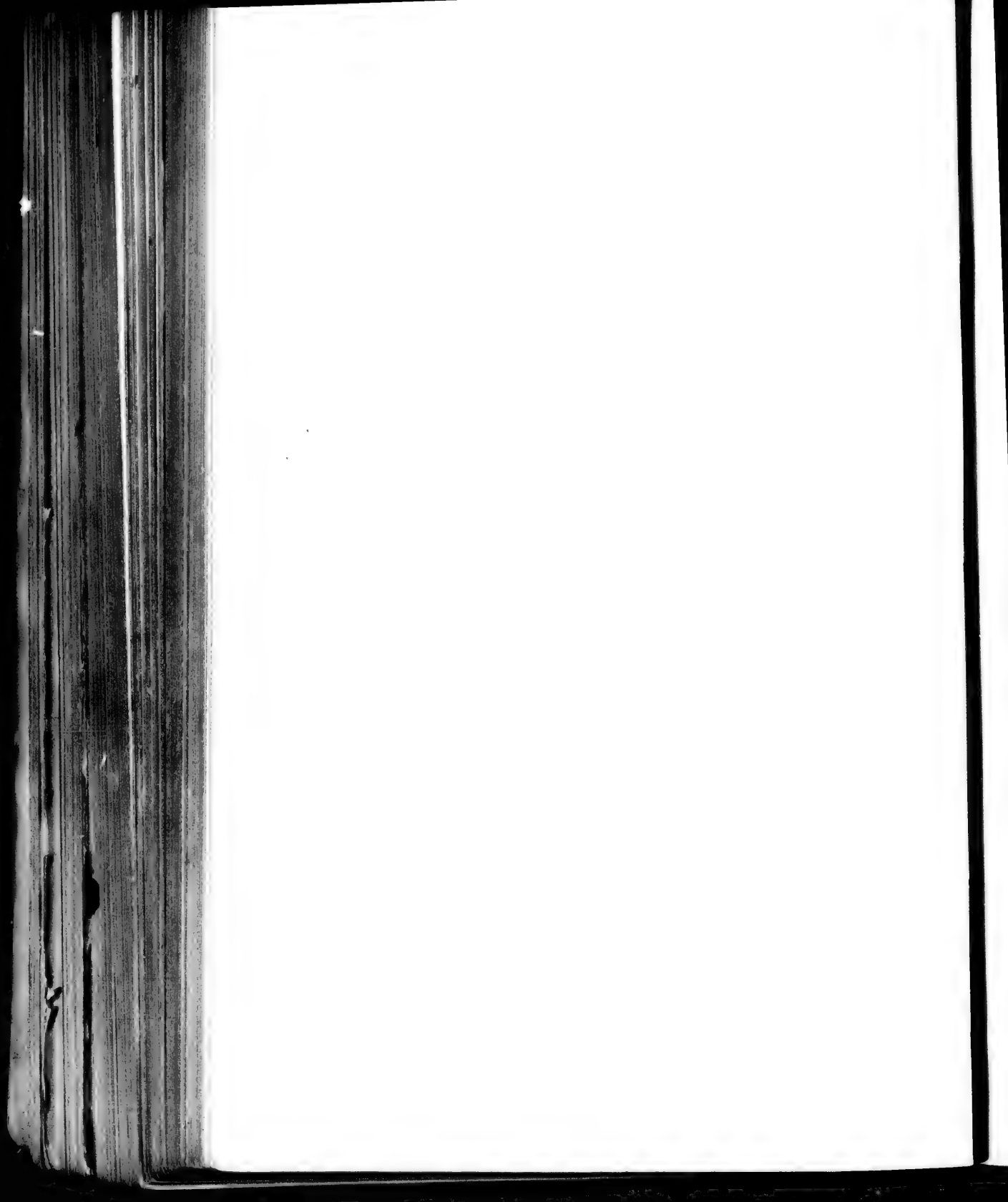


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1. Exostoses at the sacro-iliac junctions. 2. Knob-like exostosis on the promontory (Schauta). 3. Acanthopelys. 4. Rachitic pelvis with abnormal but blunt projection of ileo-pectineal eminences (Mütter Museum, College of Physicians, Philadelphia). 5. Enchondroma (Behm). 6. Fracture of the pelvis (Otto). 7. Fracture of the acetabula in consequence of coxalgia (Otto). 8. Fracture of the right ala of the sacrum (Fritsch).



internal examination discovers in the early stage of the disease the peculiar beak-like space behind the symphysis, and later the almost entire obliteration of the pelvic outlet and canal by the sinking in of the pelvic walls. If it is possible to make a satisfactory internal examination of the pelvis, the low position and the projection of the promontory at once attract attention, and the sharp angulation on the anterior face of the sacrum can be felt. On account of the exaggerated inclination of the pelvis it may be necessary to make an examination with the patient upon her side. An osteomalacic pelvis has been taken for a kyphotic, a Robert, a pseudo-osteomalacic, a cancerous, or a fractured pelvis, but a careful, methodical examination of the patient will always lead to a correct diagnosis.

Influence upon Labor.—The results of labor in osteomalacic pelvises show

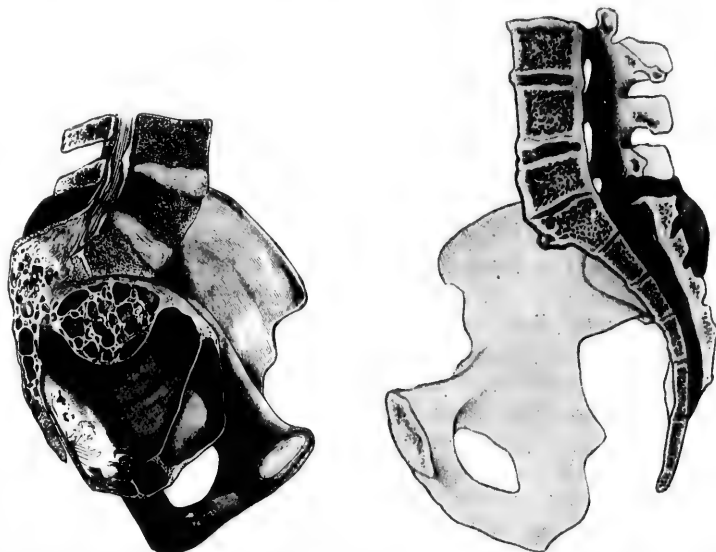


FIG. 321.—Cystic enchondroma (Zwelfel). FIG. 322.—Button-like exostosis on the promontory (Schauta).

that the obstruction is a serious one in spite of the flexibility of the pelvic bones, by reason of which flexibility in some cases the head can distend the pelvic canal sufficiently to pass through. In 85 cases collected by Litzmann forty-seven ended fatally. In another series of 128 cases the labor had a spontaneous termination in twenty-seven cases, in four there was premature delivery, and in five abortion; four times the labor was naturally terminated; in eight cases version was performed, in four the child was extracted by the feet, in twenty-five forceps was employed, in eleven craniotomy was performed, and in thirty-six Cesarean section; rupture of the uterus occurred in five women before any operation was undertaken. In still another series of cases reported from Milan the flexibility of the pelvis was so great that the child was delivered in only two instances by Cesarean section. The most successful

treatment in modern times for this obstruction in labor must be the performance of Cesarean section, and the operator should at the same time remove the ovaries, or, what is better, do a complete Porro operation. It is beyond dispute that the cessation of sexual functions favorably modifies or actually cures the disease.

Tumors of the Pelvis.—The commonest pelvic tumors are bony excrescences, usually found over one of the pelvic joints. The excrescences are originally cartilaginous projections which become ossified by an extension of bony tissue from the two bones between which they lie. These exostoses may be found over the sacro-iliac joints, over the symphysis pubis, and over the prom-

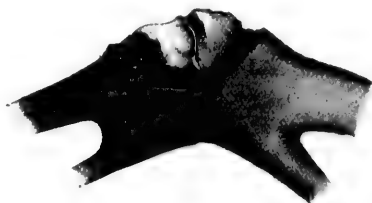


FIG. 323.—Exostosis on the symphysis (Schauta).

ontory of the sacrum (Figs. 322, 323; Pl. 33, Figs. 1, 2). They may reach the size of a pigeon's egg, though they are usually not larger than a pea or a nut. In the exostoses occupying the seat of the pubo-iliac junction, directly above the acetabula, the bony growth is apt to assume a sharp, thorny shape, projecting with its point into the pelvic inlet. Kilian was the first to direct

attention to this fact; he called a pelvis thus deformed "*acanthopelys*" (Pl. 33, Fig. 3), or a "*pelvis spinosa*." Another possible seat for a bony projection is along the crests of the pubic bones, the exostosis taking here the form of a long, sharp edge, and probably owing its origin to an ossification of the attachment of the iliac fascia, a transformation of tissue analogous to the ossification sometimes seen in Gimbernat's ligament. These bony outgrowths constitute a serious form of obstruction in labor, not so much from their encroachment upon the room of the pelvic inlet as from the sharply-localized pressure which they exercise upon the maternal structures and upon the fetal head. In the four cases reported by Kilian, death, it was claimed, resulted in each case from a perforated uterus. Other tumors of the pelvis offering an obstruction in labor are enchondromata, fibromata, sarcomata, carcinomata, and cysts (Fig. 321; Pl. 33, Fig. 5). These tumors are rare, and their importance as an obstacle in labor depends, of course, upon their size. Cysts of the pelvis are formed usually in sarcomata and in enchondromata, or are hydatid cysts. Cancer of the pelvic bones is always a secondary growth or is metastatic. It may result in a number of small tumors in the bony pelvic walls, or may take on the form of cancerous infiltration with a consequent softening of the bones like that of osteomalacia. The treatment of labor obstructed by tumors of the pelvis is ordinarily the performance of Cesarean section. There is one case on record (Abernethy's) in which the tumor, an enchondroma, was removed by an incision in the posterior vaginal wall, but in the vast majority of cases these growths cannot be reached or cannot safely be excised. In 49 cases of labor obstructed by a pelvic tumor 50 per cent. of the women and 90 per cent. of the children lost their lives (Winckel).

Fractures of the Pelvis.—Out of 13,200 fractures reported from nine large hospitals in America and in Europe, but 0.8 of one per cent. were fractures of the pelvis. When one considers that almost all grave injuries of the pelvis end fatally, the rarity of a pelvic deformity dependent upon a united fracture of a pelvic bone in a woman of childbearing age may be appreciated. Most frequently the fracture is found in the pubes, next in the ilium, next in the ischium, next in the acetabulum, and least frequently of all in the sacrum. The effect of a fracture of the pelvis upon the shape and size of its canal depends on the situation of the fracture, and may be due to distortion of the pelvic walls, to excessive callus-formation, or to ossification of the pelvic joints nearest the seat of fracture. In a fracture of the acetabulum the result of hip-joint disease the head of the femur may project into the pelvic canal (Pl. 33, Fig. 7). Fracture of the pubes results in an irregular distortion of the pelvic inlet, most marked, of course, on the injured side (Pl. 33, Fig. 6). A fracture of the upper portion of the sacrum may result in a spondylolisthetic deformity (Fig.

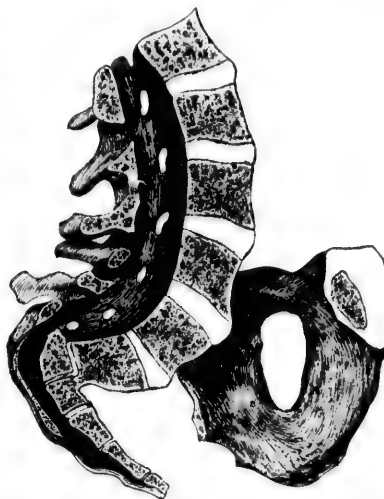


FIG. 324.—Transverse fracture of the sacrum with spondylolisthetic deformity (Neugebauer).

324). Fracture of the lower portion of the sacrum is followed by a dislocation of the lower fragment inward. In a case seen by the writer the lower half of the sacral bone was turned in at right angles to the rest of the bone by the pull of the pelvic muscles attached to it. A fracture of the sacral alæ may cause an oblique contraction of the pelvic inlet like that of the Naegele pelvis (Pl. 33, Fig. 8). Neugebauer¹¹ reported an extraordinary case of bilateral fracture of the pubic rami in which there was union with callus-formation on one side and an ununited fracture on the other, the fragments moving on one another 2 or 3 centimeters when the woman walked.

Caries and Necrosis.—The only effect of this disease of the pelvic bones is the production, in rare cases of tuberculosis of a sacro-iliac joint, of an oblique contraction of the pelvis. When the sacro-iliac joint is affected the ultimate result is the same as that produced by imperfect development of the sacral alæ in a true Naegele pelvis. There is loss of tissue, ankylosis of the joint, and an arrest of development in the affected part if the disease occurs in early childhood.

Ankylosis and Relaxation of the Pelvic Joints.—Synostosis may develop in any of the pelvic joints; in the symphysis it occurs not infrequently, and often at an early age. A number of operators have encountered this dif-

ficulty in attempts recently to perform symphysiotomy. In otherwise unobstructed labor synostosis of the pubic symphysis is not a serious condition, although it limits the slight expansion which every normal pelvis should exhibit preparatory to and during labor.

If synostosis of the sacro-iliac joint develops in the individual's early childhood, it is followed by ill development of the sacral alæ on the affected side, and of that portion of the innominate bone concerned in the formation of the joint, an obliquely-contracted pelvis of the Naegele type being the result; but such cases are rarer than those in which lack of development in the sacral alæ is the primary occurrence. If the synostosis of the joint occurs after puberty, the effect upon the pelvis and upon the course of labor is practically *nil*. If both joints are early ankylosed, a form of laterally-contracted pelvis like the Robert pelvis is the result. This kind of contracted pelvis is rarer than the transversely-contracted pelvis due primarily to lack of development in the sacral alæ.

The sacro-coccygeal joint becomes ankylosed, as a rule, between the thirtieth and fortieth years, but as the joint between the first and second coccygeal vertebrae is ordinarily unaffected, the pelvic outlet is capable of expansion during labor in its antero-posterior diameter nearly as well as if the sacro-coccygeal joint were normal. Rarely there is an ankylosis of all the coccygeal joints along with that between the sacrum and the coccyx. In these cases labor can be terminated only by a fracture of the coccyx or a laceration of the sacro-coccygeal joint. The expulsive forces of labor may be sufficient to cause this fracture, and the bone has been heard to give way with a loud crack as the head was passing through the pelvic outlet. This accident, however, is more likely to be caused by the artificial extraction of the head.

An abnormal relaxation of the pelvic joints may be a simple exaggeration of that natural process by which the pelvic canal is made somewhat expansible preparatory to labor. It is more likely, however, to be due to some pathological condition within the pelvic joints, as an inflammatory process followed, perhaps, by suppuration, the collection of fluid within the joint, osteomalacia, caries, or new growths. In pregnancy the pathological relaxation of the pelvic joints may occasion some difficulty in locomotion. During labor an exaggerated relaxation of the joints predisposes to their rupture.

The Spondylolisthetic Pelvis.—The spondylolisthetic pelvis was first described in 1839 by Rokitsansky, who reported two cases; Kiwisch and Kilian followed with a description each of a specimen; but we owe our knowledge of the condition mainly to the indefatigable researches of Neugebauer,¹² who collected more than ninety cases and specimens, and to the discoveries of Lane, who has done much to clear up the etiology. The name "spondylolisthesis" * indicates the condition—a slipping down or dislocation of the vertebrae. To affect the pelvis the spondylolisthesis must be in the lumbo-sacral region (Figs. 325–327).

Characteristics.—As the name denotes, there is a dislocation of the last

* σπόνδυλος, vertebra, and ὑλίσθησις, a slipping out or down.

lumbar vertebra in front of the sacrum, the body of the former slipping down in front of the first sacral vertebra, so that its inferior border, or in advanced cases its anterior surface, comes in contact with the anterior face of the sacrum, to which it becomes united by bony union. There is also, of necessity, an exaggerated lordosis of the lumbar vertebra and a descent into the pelvic inlet of at least the fourth and third, and even of the second, lumbar vertebræ, which diminish by their bulk and anterior projection the antero-posterior diameter of the pelvic canal. It is only the body of the last lumbar vertebra that is displaced, and not the arch, held fast by the lower posterior articular surfaces, nor the laminae surrounding the spinal cord, so that the latter does not necessarily suffer compression by the displacement of the vertebræ, although this result has been noted in a few cases (Fig. 326). To allow the displacement of the body of the last lumbar vertebra the inter-



FIG. 325.—Spondylolisthesis, well marked (Schauta).



FIG. 326.—Spondylolisthesis, beginning (Schauta).

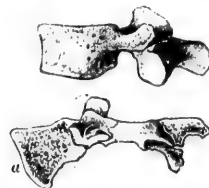


FIG. 327.—Last lumbar vertebra of spondylolisthesis (a) contrasted with a normal fifth lumbar vertebra (Neugebauer).

articular segment of the spinal arch and the pedicles are enormously lengthened from behind forward and are bent at an angle downward (Fig. 327). After a time this segment may exhibit a transverse fracture or a solution of continuity from pressure and attrition. The deformity is always gradual in development. If it develops during the childbearing period, successive labors become increasingly difficult. As the vertebra descends it pushes the sacrum backward and downward, and with it depresses the posterior portion of the pelvic brim. To compensate for this movement the anterior half of the pelvic brim rises and the height of the symphysis is increased. This movement of the pelvis diminishes very markedly its inclina-

tion, and disturbs the normal relationship between the bones and the soft structures that overlie them. The base of the triangle formed by the pubic hair in women is well below the upper edge of the symphysis, and the external genitalia are so pulled forward that the vulvar orifice is directed anteriorly as the patient sits or stands. There are, moreover, the same displacements of the pelvic bones that are seen in kyphosis—a rotation backward of the sacrum on its transverse axis, and a rotation outward of the upper portions, and inward of the lower portions, of the innominate bones on their antero-pos-

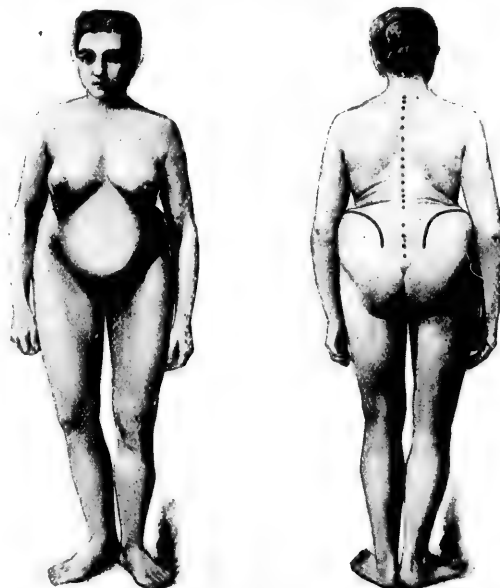


FIG. 328.—Winckel's case of spondylolisthesis of moderate degree.

terior axes. The descent of the lumbar vertebræ drags the large arteries of the lower trunk into the pelvic inlet, so that the iliac vessels and the bifurcation of the aorta can be felt in the vaginal examination. The degree of contraction in the conjugate diameter of the inlet depends upon the descent of the last lumbar vertebra and the degree of the lordosis. The contraction is usually not excessive, but it may be so great as to preclude the possibility of the engagement of the fetal head.

Etiology.—The etiology of spondylolisthesis at the lumbo-sacral junction is still involved in considerable obscurity. It has been attributed to direct injuries of, and to faults of development or ossification in, the interarticular segments of the spinal arch. It is certain that these are predisposing causes, but the observations of Lane appear to demonstrate that the commonest cause of this deformity is an exaggerated pressure from the trunk above exerted often upon healthy bone. As the result of this pressure a joint is formed in the intervertebral disk, and the interarticular segments of the last lumbar

vertebra undergo stretching, pressure, angulation, and atrophy until the bone is actually severed. Following or accompanying these changes in the arch, the body of the last lumbar vertebra is displaced farther and farther downward and forward.

Diagnosis.—The diagnosis of a spondylolisthetic pelvis is not easy, and can be made only by close attention to the patient's history, by a careful observation of her appearance, by an internal and external examination of the pelvis, and by pelvimetry. In the history of the case it may appear that the individual was the subject of a serious accident, such as a fall from a height or a fracture of the pelvis by the passage over it of a heavy weight, or it may be learned that she has carried excessively heavy burdens for a long time. The woman's height is diminished and the length of the abdomen is shortened. Viewing the patient from behind, there appears what is called the saddle-shaped or "sway" back, the lumbar vertebrae projecting visibly far forward

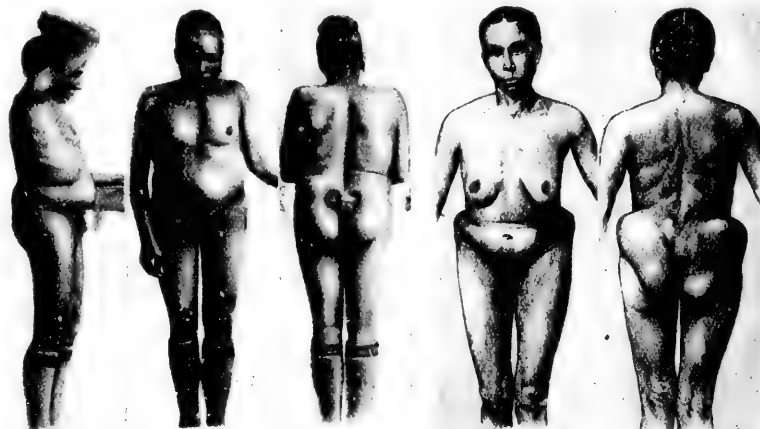


FIG. 329.—Ahlfeld's case of spondylolisthesis.

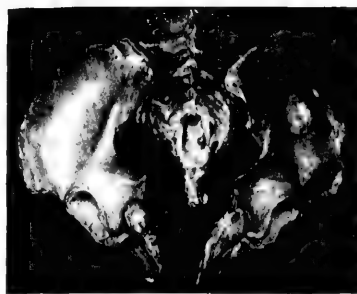
FIG. 330.—Breisky's case of spondylolisthesis.

and being displaced downward, throwing into bold relief the posterior superior spinous processes and the rims of the iliac bones, and producing quite a deep furrow along the course of the spinous processes of the lumbar vertebrae. The apposed articular processes of the first sacral and the last lumbar vertebrae stand out as button-shaped prominences on the inner surface of the posterior rims of the ilia. The buttocks are flat and are pointed below, giving to the region a cordiform appearance. In front there is a pendulous belly; a deep crease is observed running across the lower abdomen a short distance above the symphysis. Laterally, the floating ribs are seen almost to rest upon the crests of the ilia or actually to sink between them, and the soft structures of the flanks are thrown outward in prominent folds. The trunk is shortened, and the limbs appear relatively too long (Figs. 328-330). The patient's body being thrown forward by the deformity of the spine, an effort to maintain an equilibrium is made by carrying the shoulders far back; as the individual walks

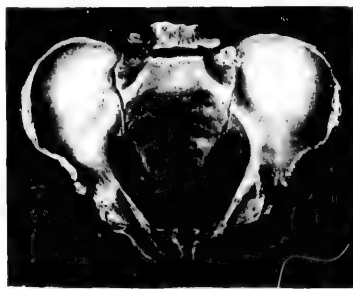
a disposition to fall forward may be noted, and she will state perhaps that she is unable to carry any load upon her arms in front of her body, for fear of toppling over upon her face. She may also complain of a grating sensation and sound in the small of the back (crepitus). The gait is peculiar; the toes are not turned outward, and the feet are swung around one another so that the foot-prints fall in a straight line. Upon an internal examination of the pelvis—best conducted, according to Neugebauer, in an upright or lateral position—the lordosis of the lumbar vertebrae is at once discovered. The angle formed by the attachment of the last lumbar vertebra to the sacrum may be detected with ease, and it is noted that the body of this vertebra does not possess lateral projections, transverse processes, or alae. By their absence one is sure that he is not feeling a projecting promontory. Pulsating iliac arteries can be felt, and it is possible even to reach the bifurcation of the aorta—a symptom first pointed out by Olshausen. But the symptom is not pathognomonic. The same sign is exhibited in the extreme lordosis of some rachitic pelvis and of the osteomalacic pelvis, also in lumbo-sacral kyphosis and in some cases of dorso-lumbar kyphosis.

The external palpation of the pelvis reveals its decreased inclination. A measurement of the pelvis will show a marked diminution in the external conjugate diameter, an increased height in the symphysis pubis, an increased distance between the posterior superior iliac spines, and a diminished distance between the anterior iliac spines and the crests. There is also some diminution in the diameters of the outlet. The internal conjugate diameter must be measured from the lumbar vertebra nearest the symphysis pubis—usually the fourth. This is called the “false” or “effective” conjugate diameter of the spondylolisthetic pelvis. On account of the decreased inclination of the pelvis it is not necessary to subtract more than the ordinary sum from the diagonal conjugate. In fact, the diagonal conjugate may approach very nearly the length of the true, or may actually measure less than it.

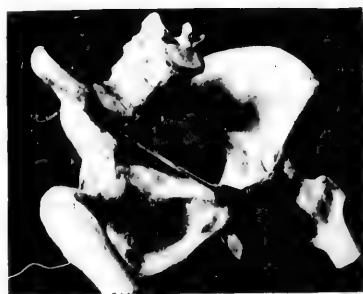
Influence upon Labor.—The influence of a spondylolisthetic pelvis upon labor is that of a flat pelvis. The obstruction in the former may be overcome more easily on account of the bow-like shape of the projecting vertebra and the coincidence of the uterine and pelvic axes. The obstruction to labor depends entirely upon the projection of the lumbar vertebrae. This projection may be so slight as scarcely to influence the progress at all, or it may be so great as to make delivery by the natural channel quite impossible. There is noticed in labor something of the same mechanism that is seen in the flat pelvis for the purpose of overcoming the obstruction—namely, decreased flexion, transverse position, and exaggerated lateral inclination of the head. On account of the forward dislocation of the external genitalia and of the pelvic floor, lacerations of the latter are the rule, and the tears are often complete into the rectum. This liability to injury is explained by the fact that the presenting part impinges directly upon the middle of the pelvic floor as it descends the birth-canal, instead of being directed forward to the vulvar orifice. Fistulae of the anterior vaginal wall are likewise common, from the



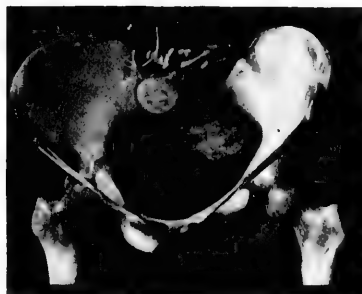
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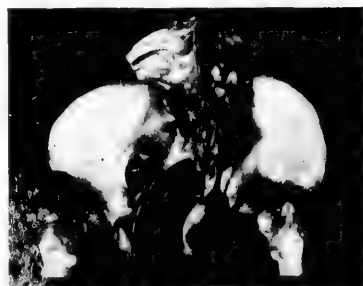
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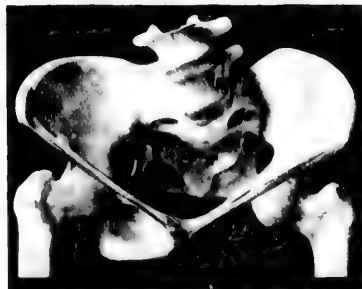
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1. Contracted outlet of a kyphotic pelvis (Barbour). 2. Kyphotic pelvis from above (Barbour). 3, 4. Lumbo-sacral kyphosis (pelvis obteta). 5. Asymmetrical contraction of the outlet from kyphoscoliosis. 6-8. Types of scoliotic rachitic pelvises.



localized pressure to which this region is subjected while the head is passing the obstruction at the inlet. The presenting part is thrown forward by the projecting vertebræ, and is received upon the prominent ridge of the pubic bone, greater in height and higher in situation than in the normal pelvis.

Treatment of Labor Obstructed by Spondylolisthetic Pelvis.—The management of labor in these cases is governed by the same principles that obtain in the management of labor in a flat pelvis. If the effective conjugate is over 9.5 centimeters, the woman can be delivered spontaneously, by forceps, or by version. With an effective conjugate of between 7 and 9.5 centimeters the induction of premature labor and the performance of symphysiotomy must be considered; or craniotomy should be done if the child is dead. If the effective conjugate is well under 7 centimeters, delivery must be effected by a Cesarean section. These rules presuppose, of course, a child of average size.

Kyphosis.—The kyphotic pelvis was first adequately described in 1865 by Breisky, although its peculiarities had been recognized before by Litzmann in 1861 and by Neugebauer in 1863. The condition was called by Herrgott "spondyl-izema," a name adopted by Neugebauer and others (Fig. 331; Pl. 34, Figs. 1, 2).

Characteristics.—The degree of deformity in a kyphotic pelvis depends upon the situation of the hump: the nearer this is to the sacrum, as a rule, the greater is the deformity in the pelvis. Ordinarily the kyphosis will be near the dorso-lumbar junction. There is a compensating lordosis of the lumbar spine, but not enough to keep the centre of gravity of the trunk from being too far forward. In consequence the weight of the trunk is transmitted in a direction from before backward, so that the sacrum is rotated on its transverse axis in a direction the reverse of that seen in rachitis—namely, backward and downward. The result of this movement is to make the sacrum straighter, narrower, more curved from side to side, and longer (Pl. 34, Fig. 2), to pull the posterior superior spinous processes of the iliac bones closer together, and to separate the anterior spinous more widely. The diminished width between the posterior superior spinous processes is caused partly by the pull of the sacro-iliac ligaments. The sacrum cannot move in any direction without dragging the ilium on each side by these ligaments, thus approximating their upper posterior surfaces. It depends also upon the narrowness of the sacrum. To compensate for the movement of the upper portion of the sacrum backward, the lower portion of the bone projects forward into the pelvic outlet. To preserve the body from falling forward, the knees and thighs are slightly flexed and the pelvic inclination is almost entirely lost. This posture puts on a stretch the ilio-femoral liga-



FIG. 331.—Kyphosis: greatest transverse diameter at outlet, 7 cm. (Mütter Museum, College of Physicians, Philadelphia).

ments, which pull outward the upper portions of the innominate bones. To compensate for the movement outward of the iliac bones, the lower segments of the innominate bones move inward upon the pelvic inlet; in other words,

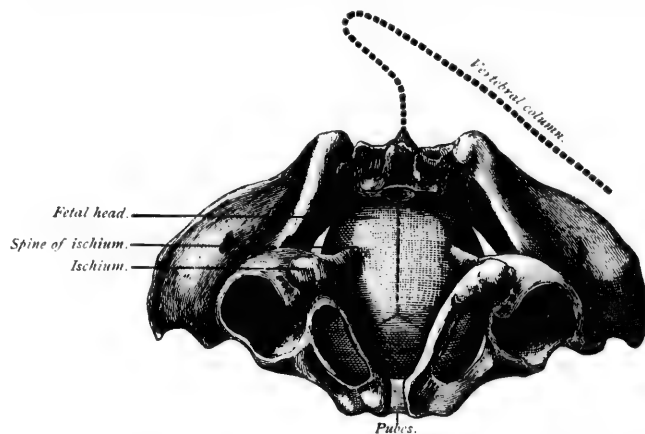


FIG. 332.—Head arrested by spines of ischia in a kyphotic pelvis (Budin).

there is a rotation of the innominate bones upon their antero-posterior axes. The result of these movements in the pelvic bones is to enlarge somewhat the pelvic inlet, especially in its antero-posterior diameter, but to contract the

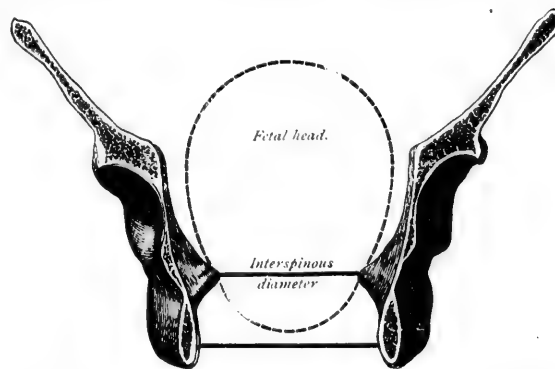


FIG. 333.—Vertical section of kyphotic pelvis, showing the head arrested by the spines of the ischia (Budin).

canal toward the outlet, where the diminution of the diameters is most marked, especially in the transverse (Pl. 34, Fig. 1).

In the rare cases of lumbo-sacral kyphosis the upper portion of the sacral bone may be involved in the necrotic process, and the sacrum may exhibit deformities by destruction of its tissues (Pl. 34, Figs. 3, 4). The other characteristic deformities of the kyphotic pelvis are most marked in this type, unless, as in one instance, the body is bent almost double, and it is necessary



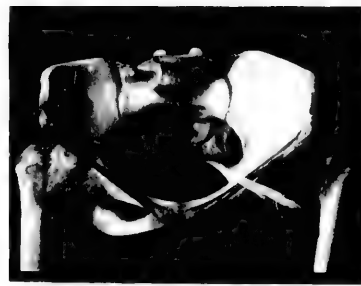
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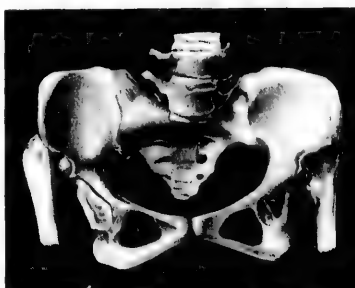
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1. Luxation of right femur. 2. Congenital luxation of both femora. 3. Luxation of left femur on dorsum of ilium, with false joint above acetabulum. 4. Congenital luxation of both femora (photograph of model). 5. Coxalgic pelvis (Mütter Museum, College of Physicians, Philadelphia). 6. Anterior dislocation of femur. 7. Congenital dislocation of the femora. 8. Pelvic deformity, the result of double club-foot (Meyer).



to rest the anterior portion upon an artificial support, as a cane. In this case the pelvis, although relieved of the weight of the trunk, is obstructed by the overhanging lumbar vertebræ to such a degree perhaps that the inlet is practically obliterated (pelvis obtecta). In all cases except the slightest of lumbosacral kyphosis the projecting lumbar spine blocks the pelvic inlet and seriously obstructs labor. In 21 labors complicated by this deformity of the pelvis 66 per cent. of the mothers and 75 per cent. of the children were lost (Winckel).

Influence on Labor.—The influence of the kyphotic pelvis upon labor is usually not felt until the presenting part has descended to the pelvic floor. In consequence of the shortened perpendicular diameter of the abdominal cavity there is a tendency always to transverse position of the fetus *in utero*, but this position is ordinarily corrected by the first few labor-pains. When the head arrives at the pelvic floor, if the occiput is directed backward, anterior rotation will very likely be prevented and there will be a persistent posterior position. If the occiput is directed anteriorly, the transverse diameter of the head may be caught between the approximated tuberosities of the ischial bones, and labor be brought to an indefinite standstill (Figs. 332, 333). Occasionally spontaneous delivery is possible on account of the extreme mobility of the pelvic joints in the kyphotic pelvis; in any case, as the progress of the head is retarded only when it reaches the pelvic outlet, the labor ordinarily is easily managed. The application of forceps may be sufficient to overcome the obstruction, but if it is not, a symphysiotomy will pretty surely do so unless the contraction is extreme or asymmetrical. Should the child be dead, craniotomy is readily performed with the head so accessible as it is on the pelvic floor.

Diagnosis.—The diagnosis of a kyphotic pelvis presents no difficulties. The hump-back is obvious, and the history is easily obtained that the spinal deformity was developed early in life. The pelvic measurements diagnostic of this deformity show an increased separation of the iliac crests and the anterior spines, a diminished distance between the posterior superior spines, an approximation of the tuberosities of the ischial bones, and some diminution in the antero-posterior diameter of the pelvic outlet. Care should always be exercised to detect asymmetry in these pelvises, to discover an arrested development with general contraction, and to diagnosticate lateral contraction at the pelvic inlet. These complicating deformities constitute often insuperable obstacles in labor.

Frequency.—The kyphotic pelvis is said to be somewhat infrequent, but the practitioner in active practice will surely encounter several examples in the course of his career. The writer has had under his care four well-marked cases of kyphotic pelvis, in one of which Cesarean section was necessary. In the other three delivery was spontaneous.

Scoliosis.—In the scoliotic pelvis there is some degree of oblique contraction. The innominate bone toward which the lumbar vertebræ are bent, receiving the greater part of the weight of the trunk, is pushed upward, inward, and backward by the extra pressure exerted upon it by the head of the femur. The acetabulum on this side is displaced anteriorly and upward;

the symphysis is pushed over on the opposite side. The degree of asymmetry is rarely sufficient to constitute an obstruction in labor. The scoliotic pelvis is, however, most often rachitic, and in addition to the asymmetry of scoliosis there may be the contraction of a rachitic pelvis (Pl. 34, Figs. 6-8).



FIG. 334.—Kyphoscoliosis (Leopold).

Kyphoscoliosis.—In a combination of kyphosis and scoliosis of the spinal column the pelvis will show, perhaps, the combined features of both, but the kyphosis, being of rachitic, not of carious origin, will not be angular, and will be situated high in the dorsal region, where it may be compensated for entirely by lumbar lordosis (Fig. 334; Pl. 36, Fig. 1). The kyphoscoliotic pelvis is usually an asymmetrically-contracted rachitic pelvis (Pl. 35, Fig. 1).

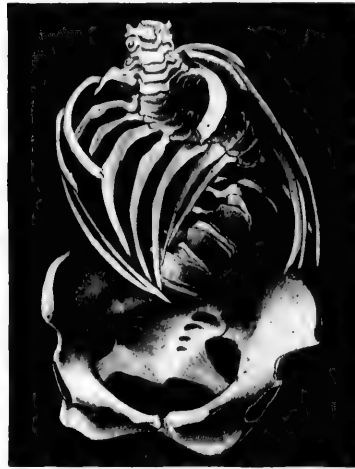
Lordosis.—Primary lordosis, not the result of pelvic deformity or of spinal disease, is very rare. Aside from some illustrations of it in an article by Neugebauer (*loc. cit.*), the writer knows of no reference to the subject except his own (Pl. 36, Fig. 2).¹³ It may readily be seen what an influence this deformity would have upon coition and parturition, and how it might be an insuperable obstacle to natural completion of the latter.

Anomalies due to Diseases of the Subjacent Skeleton: Coxalgia.—The deformity of the pelvis due to coxalgia in early childhood is of two types. In one there is an oblique contraction by a displacement of the innominate bone on the healthy side upward, backward, and inward, on account of the pressure of the femur, the weight of the body being received mainly upon the sound leg. This form of coxalgic pelvis, as a rule, presents no serious obstacle to delivery unless it is associated with a rachitic

deformity (Pl. 35, Fig. 5; Pl. 36, Fig. 3). Special attention, however, should always be paid to the length of the conjugate diameter of the inlet and to the transverse diameter of the outlet. In the other variety of coxalgic pelvis the deformity is also an oblique contraction, but it is the bone on the diseased side



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1. Lumbo-dorsal kyphoscoliosis (Schauta). 2. Lordosis from paralysis of spinal muscles (Hirst). 3. Skeleton of a girl with coxalgia (Medical Museum, University of Pennsylvania). 4. Rear view. 5. Side view, of an obliquely-contracted pelvis, the result of tuberculous disease in one knee-joint (Hirst). 6. Scoliosis from unilateral atrophy of the spinal muscles (Hirst).



which is driven inward upon the pelvic canal. This displacement of the innominate bone is the result of an arrested development on the corresponding side of the pelvis, and is very likely associated with an atrophy of the sacral ala and an ankylosis of the sacro-iliac joint. The contraction of the pelvic canal is much more serious in this form, and there may be all the difficulties in labor encountered in the true Naegele pelvis.

Luxation of the Femora.—Dislocation of the thigh-bones, if congenital or occurring early in childhood and not corrected, has some effect upon the size and shape of the pelvis, but usually not enough seriously to obstruct labor. If one thigh is dislocated, the weight of the body may be thrown



FIG. 335.—Congenital luxation of both femora: c, crest of ilium; F, trochanter of femur (Henry).



FIG. 336.—Case of congenital luxation of the femora.

mainly upon the other leg, and this may produce an oblique contraction of the pelvis of the kind already described (Pl. 34, Fig. 6). If the thigh-bone is displaced forward, the anterior half of the pelvis may be driven in a little upon the pelvic canal, and the head of the thigh-bone, as in one case reported, may project over the horizontal ramus of the pubis into the pelvic inlet (Pl. 35, Fig. 6). In the congenital luxation of both femora backward upon the iliac bones there is an excessive rotation forward of the sacrum, an increased width of the pelvic canal, and from the drag of the attached muscles and ligaments between the thighs and the pelvis the ischiae tuberosities are pulled outward, upward, and backward, so that the pelvic canal is made shallow and its outlet very wide. The heads of the femora move up and down on the ilia when the

patient walks, and the distance between the lower edge of the symphysis and the inner condyles of the femora is shortened (Figs. 335-337; Pl. 35, Figs. 2-4, 7).

In the absence of one lower extremity the pelvis may be contracted obliquely to a serious degree, as in La Chapelle's case,* by the pressure on one side of the remaining leg. Any condition which throws the weight of the body mainly on one leg may produce the same effect, as is shown in a case of the writer's (Pl. 36, Figs. 4, 5), in which there was tuberculous disease of a knee-joint early in infancy, followed by marked shortening and atrophy of the leg. The weight of the body falling mainly on the sound leg, the corresponding innominate bone is pushed upward, backward, and inward, diminishing the area of intrapelvic space on

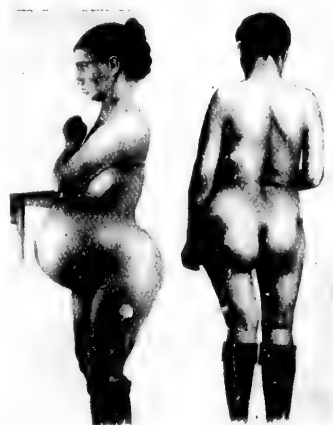


FIG. 337.—Ahlfeld's case of luxation of both femora.



FIG. 338.—Luxation and paralysis of the right lower limb (Winckel).

its own side (Fig. 338). Torggler reports an interesting case of this kind in which the disability of one leg was due to scleroderma.¹⁴ In the absence of both lower extremities there is the characteristic "sitz-pelvis," in which the innominate bones are usually rotated on an antero-posterior axis, so that the crests of the ilia are approximated and the tuberosities of the ischia are separated. Minor deformities of little practical importance may be the result of unilateral or bilateral club-foot or of the bowing of one or both lower extremities. In the former there is an increased inclination of the pelvis, an approximation of the acetabula and of the ischiac tuberosities, and a narrow pubic arch (Pl. 35, Fig. 8).

* *Pratique des Accouchements*, iii. p. 413; according to Schnauta, the only case on record.

5. THE MANAGEMENT OF LABOR OBSTRUCTED BY THE COMMONEST FORMS OF CONTRACTED PELVIS: A SIMPLE FLAT, A RACHITIC FLAT, AND A GENERALLY-CONTRACTED PELVIS.

There is no situation in medicine where experience and good judgment count for more than in the management of labor obstructed by a contracted pelvis. It is extremely difficult to formulate hard-and-fast rules for the guidance of the inexperienced where so many factors must be taken into account. The rules given below govern the writer's practice in the average case, but due attention must be paid to the history of past labors, the size of the child, the age of the woman, the build of both parents, and the probable strength of the expulsive forces, greatest in the primipara and less with successive labors.

If the diagnosis of a conjugate diameter of 9.5 centimeters or less is made during pregnancy, the physician must choose either induction of premature labor, or forceps, version, symphysiotomy, or Cesarean section at term. If the conjugate diameter measures as low as 9.5 centimeters, it is a safe plan to induce labor four weeks before the expected termination of pregnancy. This entails no additional risk upon the child if its parents are in a position to afford it the best care and nursing, and it is much the safest plan for the mother, the induction of labor, done properly, having no maternal mortality.* It is true that many women with a conjugate of 9.5 centimeters can deliver themselves without difficulty at term. Spontaneous delivery with a measurement as low as 8 centimeters and under has been recorded. But the majority of women with a conjugate of 9.5 centimeters will experience abnormal delay and difficulty in labor, with added risk to themselves and to their children; and in a certain proportion of cases a conjugate of 9.5 centimeters proves an insuperable obstruction in labor, and is the cause of ruptured uterus or death from exhaustion in the mother or of injury to the child's brain. These results are to be feared especially if the child is overgrown or if the mother's expulsive powers are weak—two conditions impossible to predict with absolute certainty. For these reasons, then, the rule to induce premature labor when the conjugate is at or below 9.5 centimeters is a safe one. If the conjugate measures 8 centimeters or under, the most successful treatment is the induction of premature labor at the thirty-sixth week, and then, if necessary, the performance of symphysiotomy when it appears that natural forces, aided, perhaps, by forceps, are not sufficient to secure the engagement of the head. By this plan the majority of women with a conjugate of 8 centimeters or a trifle less will be delivered spontaneously or with no more serious operation than the application of forceps. The combination of premature labor and symphysiotomy will usually be successful with a conjugate diameter at or above 6.5 centimeters. If the conjugate measures 7.5 centimeters or less, the induction of premature labor four weeks before term cannot be expected of itself to secure a spontaneous delivery. Symphysiotomy also will be required in the majority of instances. In such

*This statement is based upon the writer's experience in private practice, and not upon hospital statistics. It does not hold good for labors induced before the thirty-sixth week.

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cases, therefore, the operator may wait until term before he operates. But if the child may expect good care, the writer prefers the induction of premature labor in addition to the symphysiotomy, for the following reasons: The extraction of the child after the division of the symphysis will be easier, quicker, and attended with less risk to the maternal soft structures; the possibility of an overgrown child and of a failure to extract it after the symphysis is divided is avoided; and by inducing labor the operator may set the time for the operation, and may consequently make his preparations without hurry or inconvenience. With a conjugate diameter of the superior strait below 6.5 centimeters the woman should be allowed to go to term and should be delivered by Cesarean section.

If the physician sees the patient for the first time in labor, or only discovers the deformity after labor has begun, he must choose one of the following modes of delivery: A waiting policy to allow the engagement of the head by natural forces; the application of forceps; the performance of version; symphysiotomy; or Cesarean section. So long as the child is alive craniotomy should not be considered. The selection of the best mode of delivery in contracted pelves is one of the most difficult problems in obstetrics. If the patient is a primipara and the conjugate is above 9 centimeters, natural forces will in the majority of cases, provided the child be not overgrown, secure the engagement of the head,* although it may be by the expenditure of considerable force, after long delay, and only after prolonged moulding and an adaptation of the size of the head to the size of the contracted inlet by apparent anomalies in the position and flexion of the former. It is wonderful how successfully an obstruction may be overcome even in cases of contracted pelves with a conjugate of 8 centimeters or less. But while waiting for spontaneous delivery the physician may see the uterus suddenly rupture or may find the child's head after birth seriously injured. It is permissible in most cases to wait for the full, or almost full, dilatation of the os, keeping careful watch upon the woman's pulse, temperature, and general condition, upon the situation of the contraction-ring and the distention of the lower uterine segment, and taking whatever operative measures may be required in plenty of time to forestall the possibility of uterine rupture. The application of forceps to the head above the superior strait for the purpose of securing its engagement by forcible traction should in general be condemned, but it must be admitted that there are important exceptions to this rule. If one is skilled in the application of the forceps, bears in mind the transverse position of the head, and can gauge the degree of traction which may be exerted without injury to the child's skull or to the maternal

* From 1881 to 1887 there was spontaneous delivery in one hundred and sixty three out of 444 cases of contracted pelvis in the Vienna Hospital, and in forty-seven women the conjugate was not above 8.5 centimeters (Braun u. Herzfeld, *Der Kaiserschnitt u. seine Stellung zur künstlichen Frühgeburt, Wendung, atypischen Zangenoperationen, Kraniotomie bei u. zu den spontanen Geburten*, Wien, 1888, ii. p. 144). In the Moscow Maternity there were 84 contracted pelves among 4000 births in 1894, 71 per cent. of these cases were spontaneously delivered (Küster, *Centralbl. f. Gyn.*, No. 10, 1895).

soft structures, he will occasionally succeed in securing an engagement with the instrument that would otherwise, perhaps, be impossible. As a rule, however, it is safe to say that the choice lies between inaction and the performance of version. By the latter operation the smaller end of the wedge represented by the child's head is engaged in the contracted inlet, and there can be exerted upon the head coming last, both by traction on the body from below and by pressure on the head through the abdominal walls above, a degree of force that is impossible with forceps. It is well, however, to bear in mind the danger entailed upon fetal life when version is performed in a contracted pelvis. There is a considerable risk * that the head will be retained long enough above the superior strait, or in it, to asphyxiate the child beyond revival.† Or the pressure upon the head by the pelvic walls may fracture the skull and crush the brain, and the force employed in extraction may break the neck. If in the judgment of the operator the danger entailed upon the fetus by version is too great, natural forces having failed to secure engagement, and if he has tried the forceps cautiously without success, his choice must rest between symphysiotomy and Cesarean section.‡ The former must be the operation of election if the conjugate is above 7 centimeters; the latter, in cases of greater contraction. These rules for the treatment of labor obstructed by a contracted pelvis presuppose, of course, a fetal body and head of average size. This point must always be investigated carefully by abdominal palpation, although it is most difficult to determine. § If the physician has reason to believe that the child is over-size, he must allow himself sufficient latitude to ensure delivery. This advice applies particularly to cases in which the operator is in doubt whether to select symphysiotomy or Cesarean section. If, on the one hand, there is good reason to fear that the child cannot with safety to itself be extracted through the birth-canal after the former, his choice should rest upon Cesarean section. On the other hand, if the child is under-size (a condition easier to detect by palpation than is overgrowth), spontaneous delivery may be expected through a pelvis that would not permit the passage of a child of normal size.

* The infantile death-rate will be at least 25 per cent., or more likely higher (Nagel, "Die Wendung bei engen Becken," *Arch. f. Gyn.*, Bd. xxxiv.)

† Nagel reports 60 cases of version for contracted pelvis, with a fetal mortality of 25 per cent. (*Ibid.*, p. 168.)

‡ Klein and Walcher declare that by raising the buttocks and letting the limbs hang down as much as possible the conjugate diameter is lengthened by almost a centimeter. Clinical tests of the method are described, attended, apparently, with success (*Zeitschr. f. Geburts. u. Gyn.*, Bd. xxi., H. 1, and *Med. Korresp. Bl. des Würtemb. Aerztl. V.*, Bd. ix. 5). The Walcher posture has already been endorsed by quite a number of observers in Germany. The plan is worth a trial at least.

§ The relative size of head and pelvis may be determined approximately by the method of Müller and Schatz: The fetal head is grasped between the extended fingers of the physician, and is pressed down steadily and for some time upon the pelvic brim (see p. 563), the direction of the force coinciding with the axis of the superior strait. If this manœuvre succeeds in pressing the head within the pelvis, then natural forces will surely secure engagement. If it fails, the converse by no means necessarily follows.

6. OBSTRUCTION TO LABOR ON THE PART OF THE SOFT MATERNAL STRUCTURES IN THE PARTURIENT CANAL.

Congenital Anomalies of Development in the Uterus.—A double or septate uterus may complicate labor in several ways. The bulk of the

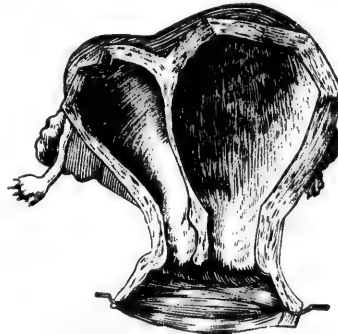


FIG. 339.—Uterus septus (Cruveilhier).



FIG. 340.—Uterus septus (Grenz).

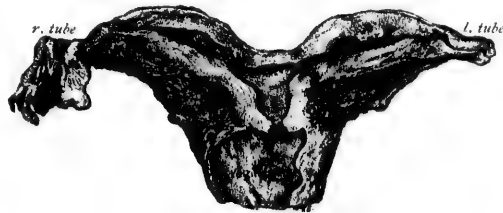


FIG. 341.—Uterus bicornis (Winckel).



FIG. 342.—Uterus didelphys.



FIG. 343.—Vagina septa (uterus biforis).

unimpregnated half may obstruct delivery, especially if this half is retroverted and is increased considerably in size in sympathy with the development of the impregnated side and is hardened in consistency by sympathetic contraction

during the labor-pains. The septum itself may prove an obstacle in labor, and sometimes labor is obstructed by the strong vesico-rectal ligament that runs between the horns of a bicornate uterus. If the placenta is attached to the septum, alarming hemorrhage may occur from imperfect contraction of the sparsely-supplied muscular fibres in it: malpresentations and a faulty direction and insufficient power of the expulsive force are common. Rupture of the uterus is to be feared on account of the ill-developed uterine walls. Laceration of the septum frequently occurs. It has been noted that a decidual membrane may be retained within the non-pregnant half of the uterus, where, undergoing putrefaction after delivery, it may give rise to septic infection. There seems also to be a disposition to the retention of membranes in the pregnant side of the womb. Retention of the placenta is not uncommon, partly because of insufficient expulsive force, partly on account of its situation, perhaps attached in both divisions of the uterine cavity. Thévard¹⁵ reports the retention of the placenta in a double uterus for fifty days, when it was spontaneously discharged. It has happened in cases of double uterus and vagina that the physician examined the wrong side, and was ignorant of the progress of labor until the child was about to be born; also that he examined first one side and then the other, finding first a dilated and then a contracted external os.

In one woman with a double uterus there was noted a disposition to become pregnant in regular alternation first on one side and then upon the other.¹⁶

Closure and Contraction of the Cervix.—The cervix may obstruct labor by reason of atresia, cicatricial infiltration, contraction, and rigidity, or there may be longitudinal or transverse septa in the canal. Atresia of the cervix in a pregnant woman must, of course, be acquired after impregnation (conglutinatiō orificiū uteri externi); it is rarely, however, complete. There is always an indication at least of the external os in a dimple evident to the sense of sight, if not to that of touch. By pressing upon this point with a finger-nail or with the tip of a uterine sound a small artificial opening may be made. Directly this is secured the dilatation of the external os proceeds in a remarkably rapid manner, although hours of vigorous labor-pains before had been insufficient to begin it. If this plan fails, a crucial incision must be made in the cervical tissues at the site of the external os. The dilatation of the small opening thus made is then left to nature. If hemorrhage follows the incisions, the bleeding points should be secured by sutures. An active treatment is always called for. Without it the uterus may rupture, the vaginal portion of the cervix may be torn off from the womb, or the head¹⁷ may emerge completely covered by the enormously distended cervix as by a caul. *Cicatricial contraction* or *infiltration* of the cervix is the result of old unrepai red tears, of operations upon the cervix, of cauterization, of syphilis, or of cancer. In the first instance the resistance to dilatation is scarcely ever great, and what there is may be overcome almost always by hydrostatic dilators, by the application of forceps and forcible delivery of the head through the cervical canal, or by the performance of version followed by rapid extraction. If the cicatrices are of syphilitic or of cancerous origin, the obstruction is more serious.

It may be overcome by radiating incisions with scissors or with a probe-pointed bistoury, but it is not unlikely to demand the performance of Cesarean section.

Rigidity of the cervix is seen normally in all primiparæ, and to an exaggerated degree in elderly primiparæ. It yields often to copious douches of warm water directed against the anterior wall of the cervix and frequently repeated—as often as once every fifteen minutes if necessary. Chloral internally and belladonna ointment applied directly to the cervix have been recommended, but these remedies are not to be depended upon except in the slight rigidity characteristic of all primiparæ. If there is delay in such cases, 15 grains of chloral every fifteen minutes for three doses may advantageously be given. An anesthetic, after all, is the most valuable medicinal agent that we possess for the relaxation of this as well as of other rigid tissues. The rigid

cervix yields at length to the steady pressure of the presenting part, and it is rarely necessary on account of rigidity alone to resort to artificial dilatation or to incisions. In the course of a slow dilatation of the cervical canal and external os the anterior lip of the cervix may become incarcerated between the head and the pelvic walls. In consequence of the pressure and the disturbance of circulation in the part the cervical tissues rapidly become edematous, and the bulk of the anterior lip becomes so great as actually to constitute a mechanical obstruction to the descent of the head. It is usually possible in such cases to push up the anterior lip over the head and above the symphysis in the intervals between the pains. If there is hypertrophy of

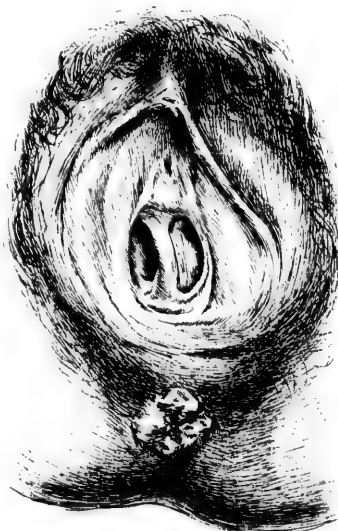


FIG. 344.—Double vagina.

the anterior lip in consequence of an old laceration and eversion, or, all the more, should there be hypertrophy of the whole infravaginal portion of the cervix, the obstruction may become quite serious, and it may be impossible to push the cervix above the head. In such cases forcible traction on the forceps or radiating incisions in the cervix may be necessary.

Longitudinal septa in the cervical canal are usually seen with duplicity of the uterine cavity from failure of the Müllerian ducts to fuse completely. Occasionally the lack of fusion is confined to the cervical canal alone (uterus biforus). Rarely transverse septa have been found in the cervical canal.* It may be necessary to cut these before the child can pass into the vagina.

* Cases are reported by Müller, Breisky, Budin, Henry, Bidder, and Blanc (*Pozzi's Gynecology*, vol. ii. p. 456).

Closure and Contraction of the Vagina or Vulva.—There may be obstruction of the lower birth-canal by longitudinal and transverse septa, by cicatrices, by hematomata, by partial atresia, especially at the upper third of the vagina, by unruptured hymen, by anus vaginalis, by vaginal tumors and cysts, by cystic and solid tumors of the vulva, by enlarged carunculæ myrtiliformes, by varices, by vaginismus, by congenital narrowness of the vagina and vulva, and by rigidity of the tissues, especially in elderly primiparæ.

Longitudinal and Transverse Septa.—These are not ordinarily very dense in structure, and they give way commonly before the advance of the presenting part. If they do not yield, it is easy to cut them in one or more places, the hemorrhage being controlled, if necessary, by sutures afterward, or in the case of transverse septa by a double ligature applied first, the septum being cut between, though there is not much tendency to bleeding even in those as thick as one's finger (Fig. 345).

Hematomata.—Hematomata of the parturient tract usually occur at the vaginal orifice, and most often between the birth of twins. They are considered here only as mechanical obstacles to labor (see p. 680). If the blood-tumor is large enough to constitute an obstruction to the escape of the child, its walls must be incised and its contents be turned out, and

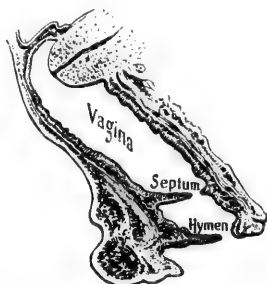


FIG. 345.—Transverse septum of the vagina (Heyder).



FIG. 346.—Anus vestibularis: dotted lines show the limit of mucous membrane; thickened skin marks the normal site of the anus (Dickinson).

if hemorrhage follow it must be checked by a firm tampon, preferably of iodoform gauze, in the cavity of the tumor.

Extensive cicatrices in the vagina from syphilitic, malignant, or other ulceration, or from former injuries, may be stretched sufficiently by hydrostatic dilators or may be severed by multiple incisions, followed by the application of forceps if the head is presenting; but they may be too dense and extensive to yield to these measures, and a Cesarean section may be required.

Unruptured Hymen.—An unruptured hymen is not necessarily a bar to conception. There are a number of cases on record in which a persistent hymen with a small orifice has obstructed to some degree the escape of the child's head in labor. In two cases under the writer's notice the advance of

the presenting part ruptured the hymeneal membrane without difficulty, but it has been found necessary by others to incise it.¹⁸

Atresia of the Vagina.—This anomaly of development has its seat usually at the upper third of the canal, where the vagina may be contracted to a narrow tract barely admitting the uterine probe, or the canal may be obstructed by an annular membrane like the hymen. Although Cesarean section has been done for this condition, the majority of cases on record have not required it. The advance of the presenting part has dilated the narrowed vaginal canal with little more difficulty than it experiences in dilating the cervical canal. At the worst the obstruction should be overcome by digital, instrumental, or hydrostatic dilatation. In complete or almost complete acquired atresia of the lower portion of the vagina, in which insemination has taken place by way of a dilated urethra and a vesico-vaginal fistula, the imperforate portion of the vagina may be opened by a transverse incision, the rectum and bladder being guarded by a finger in the one and a sound in the other.

Anus Vaginalis or Vestibularis.—This condition may complicate labor by the accumulation of feces in the rectum, due to the unnatural position of the anus (Fig. 346). In one case in which this anomaly was associated with partial atresia of the vulvar orifice it was necessary to cut the perineal structures upward from the rectum toward the pubis in order to permit the escape of the child's head.

Cystic and Solid Tumors of the Vagina and Vulva, Edema, Suppuration, and Gangrene.—In the case of solid tumors excision may be necessary, by transfixing the pedicle if they have one, and ligating it to prevent hemorrhage, or by an incision of the vaginal wall over them and their enucleation, followed by the immediate extraction of the child, and the control of hemorrhage by the needle and thread or by direct pressure. In the case of large cystic tumors a puncture is sufficient to remove the obstruction. Güder¹⁹ collected 60 cases of vaginal tumors complicating labor—23 cysts and echinococcus sacs, 18 fibroids, fibromyomata, and polyps, 14 carcinomata, 1 sarcoma, and 4 hematomata. Delivery was accomplished by the following diverse methods: spontaneously, 14; by forceps, 18; by version and extraction, 2; by traction on the feet, 1; by removal or puncture of the tumor, 16; by Cesarean section, 7; by induction of premature labor and craniotomy, 2; by premature labor, 3; by laparo-elytrotomy, 1; by craniotomy, 1; by pushing back the tumor and extracting the child past it, 2. Among the mothers there were 15 deaths; among the children, 13. In 11 of the mothers and in 22 of the children the result was not reported.

Edema of the vulva may be the result of kidney insufficiency or of pressure in a prolonged labor. The increased bulk of the dropsical labia may interfere with the escape of the presenting part, or, what is more likely, the edematous tissues lose their elasticity, obstruct labor by their rigidity, and are prone to deep tears at the time of birth and to gangrene afterward. Punctures or incisions in the labia may be necessary to escape more serious injury, but it is well to avoid them if possible, for they are apt to be followed by infection and gangrene.

An abscess of Bartholin's gland is seldom large enough to retard labor, though it has done so (Müller), but it is likely to cause trouble afterward. It should be opened freely in the early part of the first stage of labor, curetted, swabbed out with carbolic acid and glycerin, and packed with iodoform gauze.

Gangrene of the vulva is very rare before the termination of labor. Should it exist, it might determine an operator in favor of Cesarean section

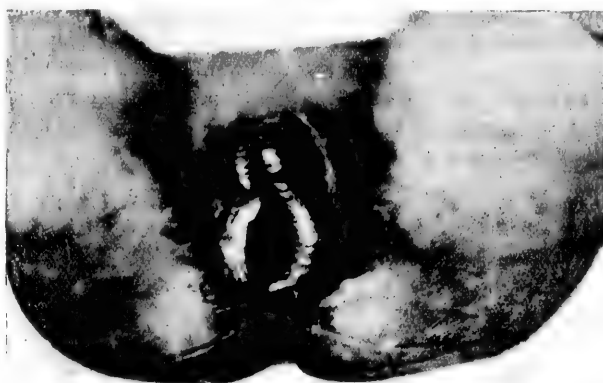


FIG. 347.—Edema and beginning gangrene of the vulva from prolonged pressure in an obstructed labor (Hirst).

in a doubtful case, on account of the rigidity of the vulvar tissues, the certainty of laceration, and the likelihood of grave infection.

Enlarged Caruncle Myrtiformes and Varicose Veins.—These tumors do not possess sufficient bulk, as a rule, seriously to obstruct the last stage of labor. They may, however, be so bruised by the passage of the head as to slough afterward, or the veins in them may be ruptured, giving rise to subcutaneous or frank bleeding of an alarming character.

Vaginismus may be overcome by an anesthetic. *Congenital narrowness* of the vagina and vulva is usually overcome by the advance of the presenting part, though often at the expense of vaginal and perineal lacerations. It may be necessary to resort to hydrostatic dilatation, or even, in rare instances, to Dührssen's plan of multiple incisions. In the case of extreme narrowness of the vulva there may be a central tear of the perineum, through which the presenting part begins to emerge. To avoid a rectal tear in such a case the perineum should be cut from the anterior border of the perforation to the posterior commissure of the vulva (Fig. 348).

Rigidity of the tissues in the cervix, the vaginal wall, and at the outlet



FIG. 348.—Central tear in the perineum, with contracted vulvar orifice (Ribemont-Dessaignes).

occasions delay in the majority of all primiparæ, but especially in the case of elderly primiparæ—those over thirty years of age. Eckhard found the infantile mortality in such cases to be 19.81 per cent., the maternal mortality to be three times as great as in younger primiparæ; and the necessity for operative interference increases steadily with the age of the primiparæ until, in those past forty, almost two-thirds are delivered by some operative procedure, usually forceps. Craniotomy should be done if the child is dead. Version is the least successful operation in these cases.

Displacements of the Uterus.—The uterus in labor may be displaced forward; to either side; downward; or backward, by the so-called “sacculation” of the womb. It may be twisted on its pedicle, the cervix, or it may form part of the contents of a hernial sac in inguinal or ventral hernia.

Anterior Displacement of the Uterus in Labor; Pendulous Belly.—This is a

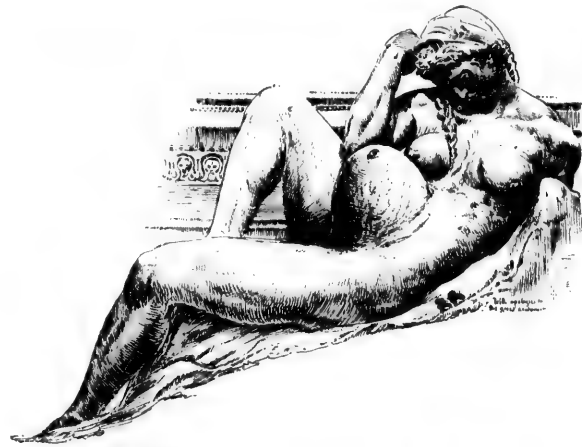


FIG. 349.—Hernia of the gravid womb through the linea alba.

common anomaly in labor, seen to some degree in all cases of obstructed labor, as in deformed pelvis, and in all cases in which the length of the abdominal cavity is decreased, as in kyphosis. A peculiar example of forward displacement is seen in those rare instances of hernia of the parturient womb between the recti muscles or to one side of the median line during the second stage of labor (Fig. 349). The pregnant womb may fall forward also into an umbilical hernia or into a ventral hernia following celiotomy.

The removal of the obstruction to labor in the first class of cases will ordinarily obviate the anterior displacement. If the displacement depends not upon obstruction, but upon flaccid abdominal walls, the application of an abdominal binder surely corrects the anteversion. In cases of hernia of the uterus through the anterior abdominal wall artificial delivery with forceps or by version may be necessary; when the uterus is evacuated it can easily be returned into the abdominal cavity. A tight abdominal binder and the dim-

intion of intra-abdominal pressure after delivery will promote the approximation of the separated recti muscles. In inguinal hernia the pregnant womb in the hernial sac is usually unicorn or bicorn (Fig. 350). Delivery may be effected by version, and this may be followed by a reduction of the hernia, but it is best to lay open the sac, incise the womb, extract its contents, and then amputate it.*

Lateral Displacement.—A tilting of the uterus to the right side is a physiological occurrence in pregnant and parturient women. The lateral inclination is sometimes exaggerated to such a degree that a great part of the expulsive force is lost by the propulsion of the presenting part against the lateral wall



FIG. 350.—Inguinal hernia containing a gravid womb (Winckel).

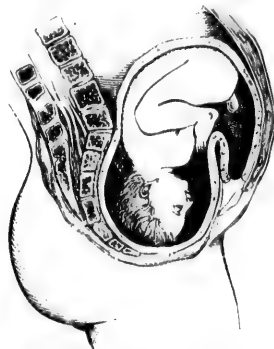


FIG. 351.—Sacculation of the uterus (Oldham).

of the pelvis. The displacement can be corrected by turning the woman on her side—usually the right—toward which the fundus uteri is inclined, and placing under her flank a rolled blanket or a pillow.

Sacculation of the Uterus.—A backward displacement of the gravid womb in rare cases goes on to full development by what is called “posterior sacculation,” the distention of the uterus to accommodate the full-grown fetus being accomplished by stretching the anterior uterine wall, the posterior wall and the fundus remaining fixed within the pelvis (Fig. 351). In these cases the cervix is high above the pelvic inlet and is pressed close against the anterior abdominal wall, the posterior vaginal wall bulges outward and downward, and fetal parts can be felt through it with a distinctness that suggests abdominal pregnancy. Cesarean section has in one instance at least been performed on account of this anomaly, but a study of recorded cases shows it to be unnecessary. By the artificial dilatation of the cervical canal and the performance of podalic version delivery can be effected without difficulty.

Partial Prolapse with Hypertrophic Elongation of the Cervix.—It is impos-

* Adams²⁰ has collected 10 cases of inguinal hernia of the gravid womb, including Doringius', which he calls “crural.” In eight Cesarean section was done. In one the delivery was spontaneous.

sible for pregnancy to proceed to term with complete prolapse of the womb, although the size of the uterine tumor projecting from the vulva in some cases



FIG. 352.—Prolapse of a double uterus in a pregnant woman (Maygrier).

has given rise to a belief in this possibility (Fig. 353). A careful examination has always shown the major portion of the uterine body to be within the pelvic and abdominal cavities. Commonly the fundus is at a normal level, and the descent of the cervix has been



FIG. 353.—Partial prolapse of the womb in labor (Wagner).

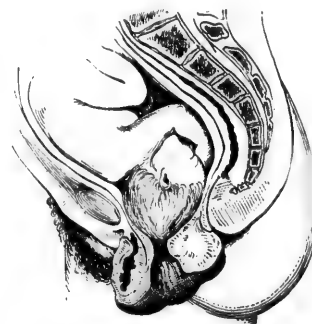


FIG. 354.—Partial prolapse of the womb and hypertrophy of the cervix (Faivre).

accomplished by stretching the lower uterine segment and by hypertrophic elongation of the cervix itself. When the contraction of the uterine muscle

begins in labor a partial prolapse of the womb is usually spontaneously corrected by the retraction of the cervix within the vagina. This the writer has seen in several instances. In exceptional cases, however—usually on account of a rigid cervix—the prolapse becomes aggravated or suddenly

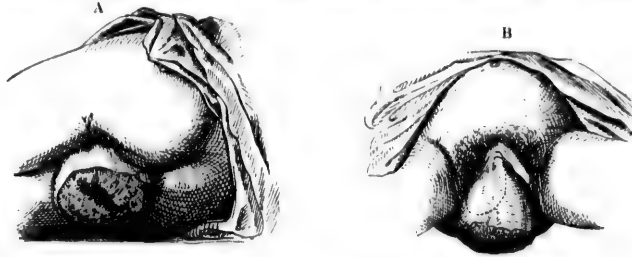


FIG. 355.—Partial prolapse of the womb and hypertrophy of the cervix: A, lateral position; B, dorsal position (Faivre).

makes its appearance, and the cervical tissues, growing edematous and becoming enormously swollen, constitute by their bulk and increased rigidity a serious obstruction to the delivery of the child. This difficulty was overcome in an ingenious manner in a case reported by Faivre.²¹ The woman was placed



FIG. 356.—Displacement of the cervix.

in the dorsal position across the bed, a forceps was applied to the child's head, and an assistant, standing astride the woman's body, hooked his fingers into the cervix and pulled upward to counteract the traction of the forceps upon the child's head and the incarcerated cervical tissues. It might be necessary

in such a case to enlarge the cervical canal by radiating incisions. The hemorrhage following might be controlled temporarily by clamping sutures over the wounded surfaces without uniting them (Figs. 354, 355).

Displacement of the Cervix.—It is not uncommon in primiparæ with a narrow cervical canal for the cervix to be displaced backward, so that the external os, almost inaccessible to the examining finger, points directly backward or even backward and upward. The anterior lower uterine segment is much distended by the presenting part and occupies the whole vaginal vault. The expulsive force in labor is exerted against the lower uterine segment, and the cervical canal remains undilated. The difficulty can be overcome by applying an abdominal binder and by hooking the cervix forward with the finger during two or three pains (Fig. 356).

Tumors of the Genital Canal.—*Carcinoma of the Cervix.*—In a large proportion of cases cancer of the cervix will interrupt gestation at various

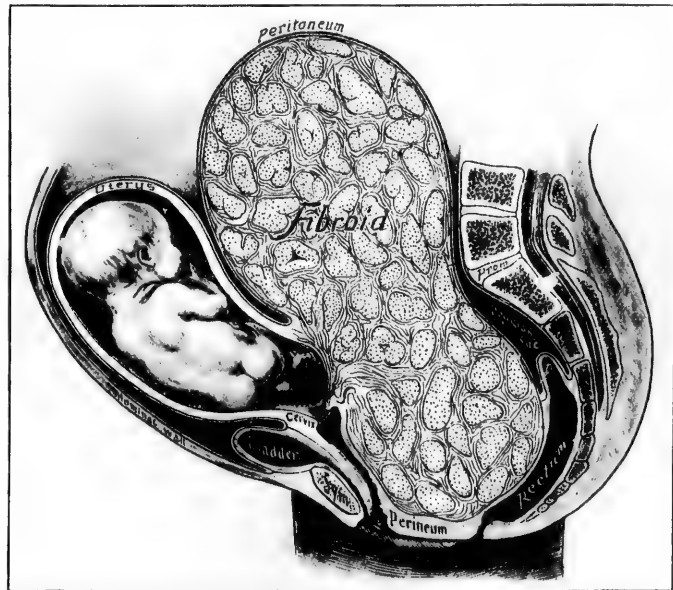


FIG. 357.—Large fibroid blocking the pelvis (Spiegelberg).

stages, but in a certain percentage (66, according to Müller) the pregnancy goes to term. If the disease is not too far advanced, if it is confined to one lip of the cervix, and that the anterior, and if there is not too much cicatricial infiltration around its periphery and up the cervical walls, the labor may be terminated spontaneously, but this is rather the exception. The performance of Cesarean section is commonly the proper treatment for labor obstructed by carcinoma of the cervix, and this operation should be selected if there is good reason to doubt the possibility of spontaneous or artificially-assisted delivery by the natural passage-way. The woman's life is surely doomed in the near

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future, and the child at any rate should be saved, even at considerable risk to the mother. It may be desirable to operate before the fetus has reached maturity if the disease is making such rapid progress that the maternal life is not likely to endure until the natural end of pregnancy.

Fibromata.—Fibroids of the uterus and cervix low enough in situation to become incarcerated in the pelvis are likely to constitute insuperable obstructions in labor, besides complicating parturition by favoring abnormal positions of the child, by predisposing to adherence of the placenta, to prolapse of the extremities and cord, and to hemorrhage during and after labor. If the tumor grows on the anterior wall of the uterus, the first few labor-pains and the contraction of the longitudinal fibres of the cervix may dislodge it above the pelvic brim, though it had been impossible to do this before by manipulation. The writer has seen one such case. It is also possible for tumors on the anterior wall of the cervix to be pushed out of the vulva in front of the presenting part, thus making room for the escape of the latter. If, however, the tumor is situated laterally or posteriorly, its artificial displacement upward into the abdominal cavity, so that the child may escape past it, is often impracticable (Fig. 357). On the contrary, the attempt at descent of the presenting part in labor must fix it more firmly in the pelvic cavity.* In this case, if attempts under anesthesia to dislodge the tumor and to push it above the pelvic brim fail, a Porro-Cesarean operation should be performed, even though the tumor is not of such great size as absolutely to prevent the delivery of the child. The physician must consider the effect upon it, owing to its low vitality, of the pressure to which it will be subjected by dragging the child past it (Fig. 358). Sloughing, gangrene, and fatal infection are likely to follow. This was the history of the case illustrated in Figure 358, communicated to the writer by Dr. J. P. Simpson of South Carolina. If the fibroid is submucous and grows from the cervix, it may be enucleated when labor begins. The bed of the tumor should be packed with gauze after labor.†

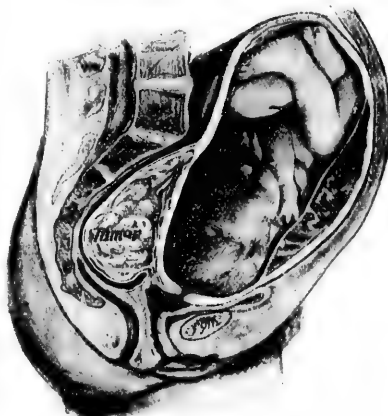


FIG. 358.—Small fibroid past which the child was extracted. The tumor became gangrenous and the woman died (Simpson).

* It is barely possible that a tumor low down on the posterior wall of the cervix, the most unfavorable of all positions, may be suddenly elevated after many hours of labor, and thus allow a spontaneous delivery; but this event is not to be counted on in practice.

† Sutugin is an enthusiastic advocate of vaginal operations for all cases of fibroids impacted in the small pelvis. For intramural tumors the cervix is split until the tumor is reached. For subserous tumors the vaginal vault is opened. Nine such operations *sub partu* are reported, with only one death (*Jahresb. ü. d. Fortsch. a. d. Gebiete der Geburtsh., etc.*, vol. v. p. 175).

It is, unfortunately, a common error to overlook a fibroid tumor obstructing the pelvis in labor or to mistake it for the fetal head. The woman is allowed to die of ruptured uterus, exhaustion, or hemorrhage while the physician is waiting for the descent of the presenting part or is endeavoring to apply the forceps to what he takes to be the head. Ordinary care and some little experience in making obstetrical examinations should guard a practitioner against such an egregious mistake.

The prognosis of labor complicated by a fibroid tumor depends upon the early recognition of the growth and upon the treatment. In general practice the results have hitherto been bad. Nauss found a maternal mortality of 54 per cent. among 225 women, and an infantile mortality of 57 per cent. in 117 cases. Süsserott found in 147 cases a maternal mortality of 50 per cent. and an infantile mortality of 66 per cent.²²

A fibroid tumor may prolapse into the pelvis after the birth of the child and prevent the delivery of the placenta.

In Lefour's statistics of 300 cases of fibroids complicating labor the mortality of delivery by the natural passage was 25 to 55 per cent. for the mothers, 77 per cent. for the children.²³

Polypi.—Polypoid tumors obstructing labor usually spring from the cervical canal or the anterior lip, and are mucous in character. They may, however, be fibromyomatous, fibrous, or sarcomatous, and may have a situation high in the uterine cavity or in its wall. They may increase very markedly in size during pregnancy. Their pedicle is usually small, and in the case of cervical polyps their removal is easy. The operation should be postponed, however, until the woman falls into labor, for any operative interference in this region would very likely interrupt gestation. When the dilatation of the os begins the pedicle can be transfixed and ligated and the tumor be cut away. Even if these growths are not sufficient in bulk to obstruct parturition mechanically, they have been known to give rise to profuse hemorrhage in the first few days of the puerperium, and their removal is desirable, therefore, even though they be small in size. In the case of fibromyomatous polyps of the uterine body, the tumor has on rare occasions been torn from its pedicle during labor and expelled in front of the child.

Tumors of Neighboring Organs.—*Ovarian Cysts.*—An ovarian cyst is a rare complication in labor. In 17,832 births in the Berlin Frauenklinik an ovarian cyst was found only five times. The number of abortions in pregnancies complicated by ovarian cysts is somewhat larger than common, but still a large proportion of these cases proceed to term. Of 321 pregnancies complicated by the presence of ovarian cysts, there was premature interruption in fifty-five (Remy). If the cyst is discovered during pregnancy, its removal should be attempted. Ovariectomy during gestation is not necessarily a difficult or dangerous operation, nor does it, as a rule, interrupt pregnancy.* If

* Dsirne has collected statistics of 135 operations with a mortality of 5.9 per cent. Pregnancy is interrupted by the operation in about 20 per cent. of cases (Flaischlen, *Zeitschrift für Geburtshilfe*, xxix. p. 49).

the tumor is first discovered after the woman has fallen into labor, and if it has become displaced downward into the pelvic cavity and is incarcerated, resisting all efforts to displace it upward even under anesthesia, its puncture through the vaginal vault, after a thorough cleansing of the vaginal mucous membrane and with a thoroughly aseptic technique, is said to give the best results. It is a matter for serious consideration, however, whether Cesarean section followed by the removal of the tumor is not better. It is the writer's conviction that it is. By this plan many dangers in the puerperium are escaped. Twisted pedicle, intra-cystic bleeding and shock, occlusion of the bowels, rupture of the cyst, suppuration of the cyst-contents and consequent peritonitis, are all surely avoided. A number of cases treated thus should give a better mortality record than has hitherto been secured. In Heiberg's statistics of 271 cases there was a maternal mortality in pregnancy of more than 25 per cent. and a fetal mortality of more than 66 per cent. In deliveries by forceps without puncture of the cyst the maternal death-rate has been 50 per cent.; with puncture almost as great; and after version without puncture more than 50 per cent. Flaischlen recommends the vaginal puncture, or if necessary a vaginal incision and thorough evacuation of the tumor, then the delivery of the child, and on the following day at the latest an abdominal section for the removal of the tumor. This procedure does not seem to the writer so good a plan as the coincident Cesarean section and ovariectomy. Should the physician prefer vaginal puncture—which requires, of course, no special surgical skill—he should remember that if the tumor be densely adherent, possess thick walls, and possibly be a dermoid cyst, puncture through the vaginal vault is likely to be followed by gangrene of the tumor-contents and walls and by general infection. This will necessitate a hurried abdominal section in the puerperium, with the patient in a bad condition to endure it. Moreover, if the cyst is multilocular, it may be impossible to reduce its size sufficiently by vaginal puncture to permit the delivery of a living infant. The writer has experienced both the disadvantages of this plan of treatment.

Spontaneous delivery in spite of an ovarian cyst incarcerated in the pelvis has been noted after the cyst ruptured, after it had been spontaneously dislodged upward above the brim, or had perforated the vaginal vault or the rectum. As an ovarian cyst must be impacted in the pelvis to obstruct the delivery of the child, it is easily understood that there is more difficulty and danger in labor from a small than from a large tumor (Fig. 359). After the child is born a cyst that had before been above the brim may descend into the pelvis and obstruct the delivery of the placenta.

Vaginal Enterocoele.—Vaginal hernia is a very rare obstruction in labor. The writer has been able to collect but 27 cases from medical literature. Of these, only two were anterior enterocoeles; the others were lateral and posterior. The distention of the hernial sac in labor is apt to become excessive, and to threaten its rupture with protrusion of intestinal loops. An effort should be made to reduce the hernia as soon as it is discovered. The reduction may be facilitated by placing the woman in the knee-breast posture and by inserting

the whole hand into the vagina. If this treatment is instituted in pregnancy, it should be followed by the insertion of a large tampon or a globe pessary and by prolonged rest in bed; in labor the presenting part should immediately be brought down past the hernial ring. If there are adhesions about the latter, preventing the reduction of the hernia, the tumor should be supported and held to one side by assistants while the child is artificially extracted by forceps or after version. Should the sac rupture and the intestines protrude, the child must be delivered hastily, the intestines be cleansed thoroughly and replaced, and the opening be sewed up. In the case of a very large irreducible vaginal hernia the writer's preference would be for Cesarean section in a labor at term.

Other growths or tumors in the pelvic inlet and cavity obstructing labor have been fibrocystic tumors of the ovarian ligament, requiring an abdom-



FIG. 359.—Ovarian tumor incarcerated in the pelvis during labor.



FIG. 360.—Cystocele obstructing labor.

inal section; fibroma of the ovary; sarcoma of the ovary; a displaced adherent kidney at the pelvic inlet, necessitating version and forcible extraction;* hydatid cysts of the pelvis, demanding Cesarean section; a displaced and enlarged spleen; masses of exudate; and an aneurysm of the gluteal artery.

Cystocolpocele and rectocele should be replaced if they protrude to a great extent in front of the head, and be held back until a forceps is applied and the head is brought past them with the instrument (Fig. 360). Version and extraction have occasionally been found necessary. Large fecal masses in the rectum must be removed by an enema or must be dug out.† Calculi in the bladder should, if possible, be discovered and removed by the urethra or by vaginal lithotomy before the second stage of labor. They may become nipped between the head and the pubic bones, and pinch a hole through the anterior vaginal

* Runge reports four cases (*Archiv für Gynäkologie*, xli. p. 99). The writer has had one. Albers-Schoenberg reports another in which the uterus ruptured (*Centralblatt für Gynäkologie*, Dec. 1, 1894).

† Corradi tells of a case in which seven pounds of hardened feces were removed before the woman was delivered.

wall and bladder if they are overlooked or neglected.* The diagnosis of vesical calculus in the parturient woman appears to be somewhat difficult: it has been taken for a pelvic exostosis or some other pelvic tumor, and in one case at least Cesarean section was performed on account of this mistake. Fortunately, vesical calculus in the female is rare. In 10,000 women examined by Winckel in fifteen years it was found only once.

The following conditions in and about the rectum may present mechanical obstacles to delivery: Cancer, anus vestibularis or vaginalis, foreign bodies, contraction of the levator ani muscles, benignant tumors such as cysts of the rectum, ovarian cysts which have perforated the rectum, and retro-rectal dermoid cysts. Each of these conditions must be treated according to the individual indications. Incisions in the perineum may be required, foreign bodies must be removed, resisting muscles on the pelvic floor may be overcome by an anesthetic and by the application of forceps, and cystic tumors should be punctured or removed after ligation of their pedicles. Cancer of the rectum may demand the performance of Cesarean section by reason of the size of the tumor and the cicatricial infiltration of the birth-canal, as in Freund's case.

7. OBSTRUCTION IN LABOR ON THE PART OF THE FETUS.

Overgrowth of the Fetus.—Excessive overgrowth of the fetus is rare. The writer searched the records of more than 1000 children in the Maternity Hospital of Philadelphia before he found one that weighed more than twelve pounds; weights, however, of fifteen, sixteen, eighteen, twenty-three and a half, and twenty-eight and three-quarters pounds have been recorded. The causes of overgrowth in the fetus are prolongation of pregnancy, over-size and advanced age of one or both parents, and multiparity. Rarely it may be inexplicable. The first named is in the writer's experience the most common cause. In 6 per cent. of women pregnancy may be expected to be prolonged beyond the three-hundredth day, and for every day that the fetus is retained in the womb beyond the usual time there is commonly some little increase in its size and weight above the normal. So much difficulty and danger may be experienced from this cause that it is a good rule in practice to allow no woman to exceed the normal duration of pregnancy by more than two weeks. By inducing labor at that time one will occasionally interfere unnecessarily, but he will often avoid complications and difficulties of the most serious nature.

Over-size and advanced age of one or both parents may be a cause of overgrowth in the fetus—the latter usually because it predisposes to a prolongation of pregnancy. It is commonly asserted that the size of children increases in successive pregnancies up to the fourth or fifth, and then remains stationary

* Kotschurowa has reported a case in which labor lasted three days. At the end of that time a gangrenous tumor protruded from the vulva, which tumor proved to be the bladder and anterior vaginal wall. The midwife in attendance perforated the tumor with her finger, whereupon a calculus eighty-five grains in weight was discharged (*Jahresbericht u. d. Fortschr. a. d. Gebiete der Geburtsh., etc.*, vi. 225).

or even decreases; but there are important exceptions to this rule. The writer has seen the tenth child vastly exceed in size the nine preceding; it weighed



FIG. 361.—Dicephalus.

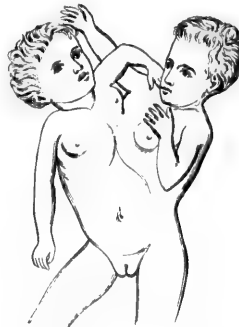


FIG. 362.—Lymphangioma.



FIG. 364.—Craniopegus.

FIG. 363.—Dicephalus.

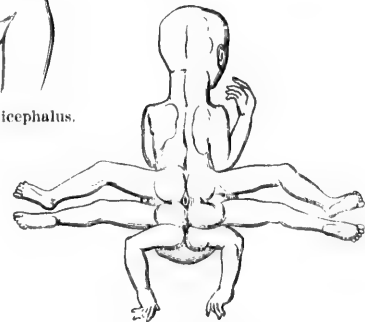


FIG. 365.—Ischiopagus.

fifteen pounds, and it was necessary to deliver it by Cesarean section. The other children had been born naturally through a flat pelvis with a conjugate



FIG. 366.—Dipygus (Wells).



FIG. 367.—Dipygus parasiticus.

diameter of 9 centimeters. The increase in size of successive children must be borne in mind in cases of contracted pelvis. The first two or three infants



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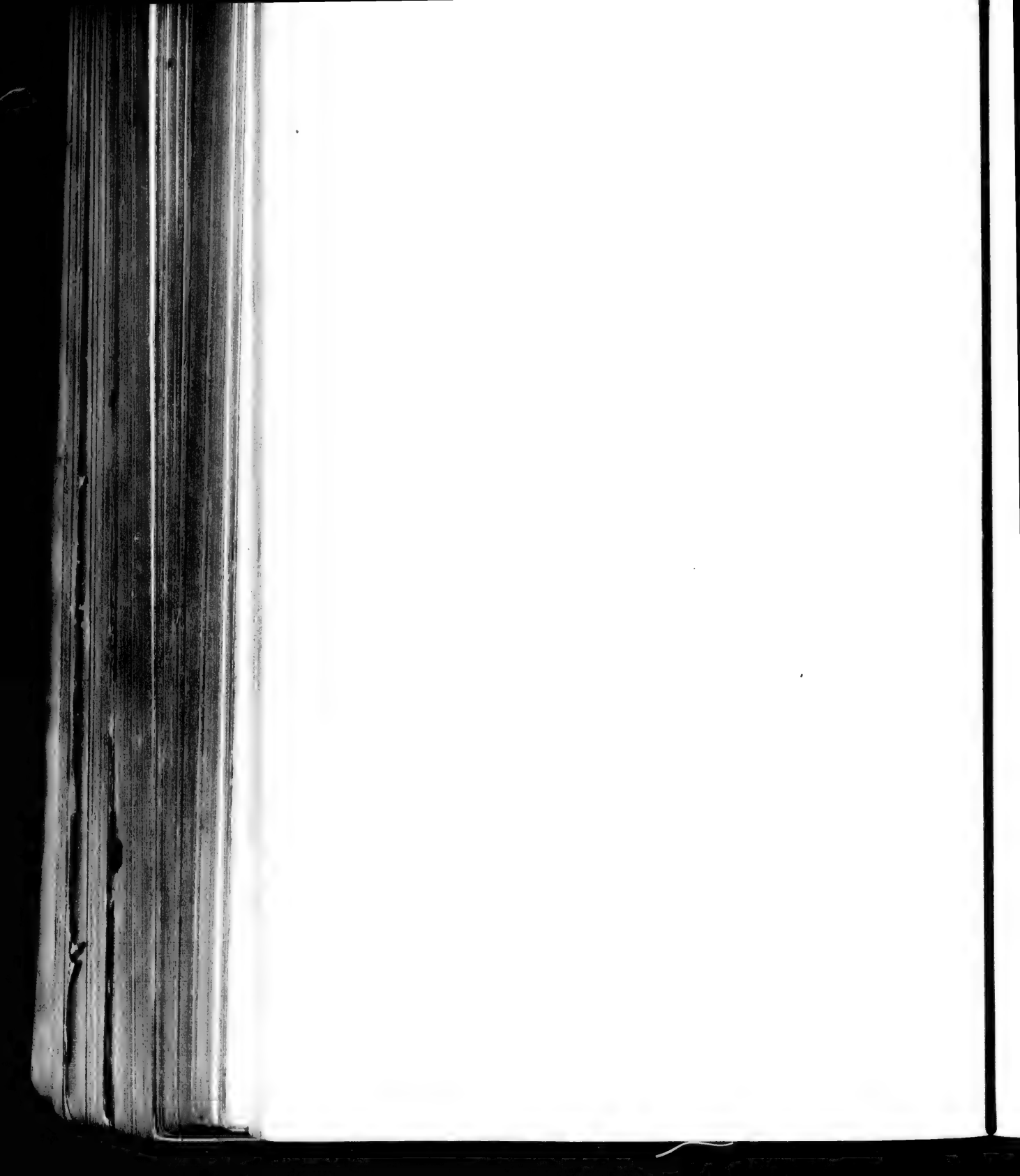


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1. Diprosopus (Hirst and Piersol). 2. Diprosopus (Fleming). 3. Dicephalus. 4. Large cystic kidneys (Fussell). 5. Large meningocele and spina bifida (Hirst and Piersol). 6. Congenital cystic elephantiasis (Wilson). 7. Thoracopagus (Hirst and Piersol). 8. Distended bladder (Ahlfeld).



may be delivered spontaneously, but the larger size of the fourth or fifth may make natural delivery impossible.*

Overgrowth of the fetus is the most difficult condition in obstetric practice to diagnose with precision. A careful palpation of the head and body and an attempt to push the former into the pelvic inlet may give one an approximate idea of the relative size of fetal body and pelvic canal, but as a matter of fact the large size of the fetus is usually discovered in practice only

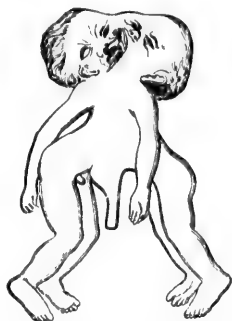


FIG. 368.—Prosopothoracopagus.

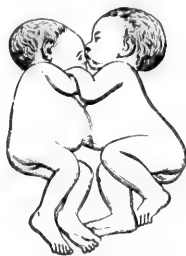


FIG. 369.—Xiphopagus.



FIG. 370.—Janiceps.

after prolonged delay when attempts at artificial delivery, especially by version, have failed. By this time the fetus is commonly dead, and should be delivered by embryotomy. But the practitioner must be on his guard against futile attempts to deliver an infant too large, even when mutilated, to pass through the pelvis. The writer has seen in consultation practice several maternal deaths due to this cause.

Premature Ossification of Cranium; Wormian Bones;† Large Heads; Malformations and Tumors of the Fetus.—No single rule of treatment can be laid down for the management of these cases. Forceps, version, or some form of embryotomy is usually demanded. Spontaneous labor, however, is possible even in cases of monstrous bulk in which delivery through the birth-canal would seem out of the question. Thus in double monsters joined loosely by the front or back (xiphopagus, the Siamese twins; pygopagus, the Hungarian sisters), one child will be born by the head, the other afterward by the breech, or *vice versa*. In dicephali one head may be pressed into the neck of the other or may rest upon the iliac bone till the first head makes its escape from the vulva. Even in thoracopagus, the commonest double monstrosity, in which two trunks

* Lehmann in 712 labors through 198 contracted pelves found increasing difficulty in delivery with each succeeding labor. In first labors 50 per cent. ended spontaneously; in second, 43.8; in fourth, 38.4; in fifth, 33.4; and in labors after the fifth only 9.8 per cent. (*Inaug. Dis.*, Berlin, 1891).

† Dr. Grace Peckam (*New York Medical Record*, April 14, 1888) has reported three stillbirths, attributed in each instance to the development of Wormian bones in the smaller fontanelle, and to the consequent interference with overlapping of the cranial bones at the sutures. This observation has not yet been verified by others.

are intimately joined front to front (Pl. 37), spontaneous labor is possible by the mechanism shown in Figures 374 and 375. On the other hand, the greatest difficulty may be encountered in labor, and the most serious operation may be demanded to deliver the woman.*

Fetal tumors obstructing delivery may be hydrencephalocoeles, lymphangiomas, myxomata, sacral teratomata. Cystic tumors should be punctured. Solid tumors may call for version or for embryotomy. Craniotomy may be required in monstrous enlargement of the cephalic extremity, as in syncephalus or in diprosopus. Decapitation may be necessary in duplicity of the cephalic extrem-



FIG. 371.—Myxoma of neck (Longaker).



FIG. 372.—Sacral tumor (Mütter Mus., College of Physicians).



FIG. 373.—Anasarca.

ity, as in dicephalus or in thoracopagus. In Reina's case of tricephalus the first head was perforated and then amputated, the second was perforated, crushed, and amputated, and the third was amputated.



FIG. 374.—Mechanism of labor with dicephalus (Küstner).

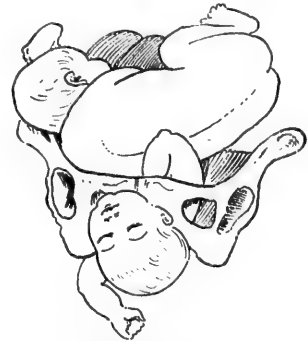


FIG. 375.—Mechanism of labor in thoracopagus (Küstner).

Diseases and Death of the Fetus.—All diseases of the fetus that increase

* There are two recorded deliveries of thoracopagi by Cesarean section (Hirst and Piersol, *Human Monstrosities*).



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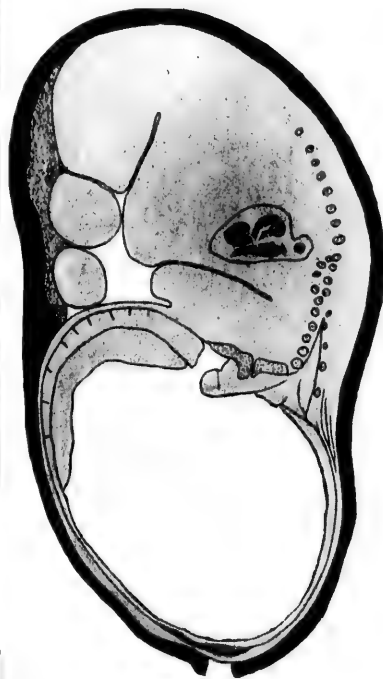
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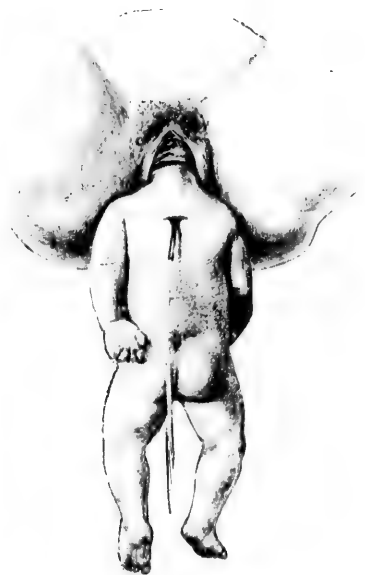
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1. Skeleton of hydrocephalus (Hirst Collection, University of Pennsylvania). 2. Hydrocephalus (Hirst). 3. Hydrencephalocoe posterior (Hirst and Piersol). 4. Hydrencephalocoe superior. 5. Hydrocephalus distending lower uterine segment (Varnier). 6. Tapping a hydrocephalus through the spinal canal.



its bulk may constitute thereby an obstruction in labor. Cystic tumors, effusions in the serous cavities, anasarca, an enlarged liver, polycystic disease of the kidneys,²¹ and distended bladder from atresia of the urethra* are examples. Liquid accumulations should be evacuated by puncture or by incisions.

Hydrocephalus (Pl. 38) is the most important condition under this head. It is not very rare,† is often overlooked, and is a frequent cause of ruptured uterus.

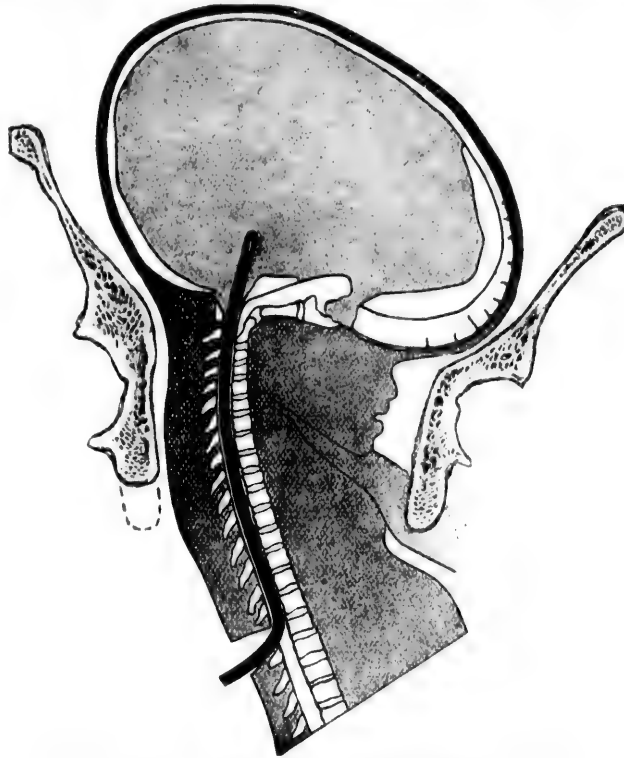


FIG. 376.—Tapping a hydrocephalus through the spinal canal (Varnier).

The *diagnosis* can be made by a vaginal examination, by abdominal palpation, and by a combined examination, or, if necessary, by anesthetizing the woman, introducing the whole hand into the vagina, and thoroughly palpating the enlarged head resting above the pelvic brim. The wide-open fontanelles, the great width of the sutures, the fluctuation to be felt perhaps in these regions,

* Schwyzer (*Arch. f. Gyn.*, Bd. 43) has collected 13 cases of dilatation of the fetal bladder from atresia of the urethra, stenosis of the urethra, and obstruction of the urethra by a valve-like formation of mucous membrane. Müller reports a case and quotes another (*Arch. f. Gyn.*, Bd. 47, H. 1).

† Schuchard found it sixteen times in 12,055 births; Lachapelle and Dugés, fifteen times in 43,555; Merriman, once in 900. In 159 cases there were 38 maternal deaths, twenty of which were from rupture of the uterus.

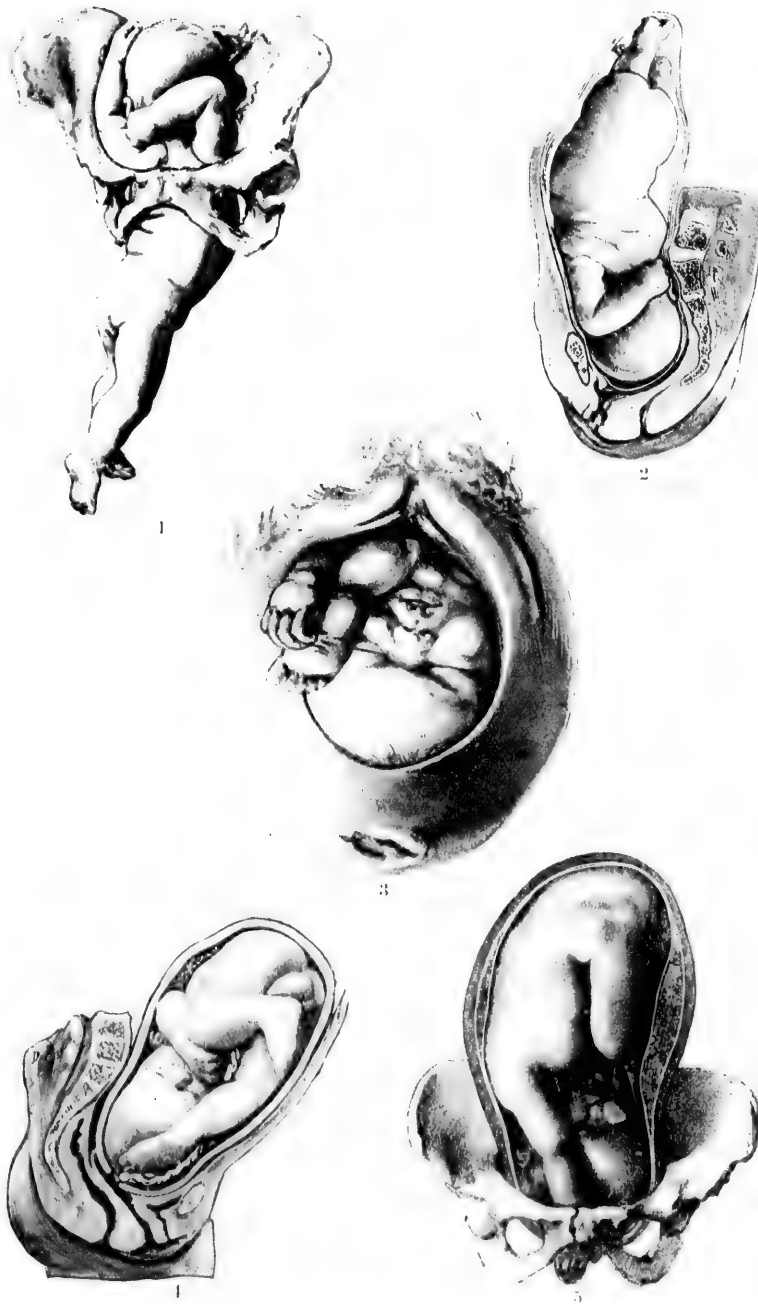
the large size of the head appreciated by bimanual examination, and possibly the abnormal mobility of the cranial bones, and in some cases their extreme tenuity, indicate the condition. Hydrocephalus is very often overlooked in practice as the result usually of a careless, superficial examination. A painstaking and methodical investigation of a suspected case should avoid this error. There are cases, however, in which there is no increased width of the sutures, no enlargement of the fontanelles, and such slight enlargement of the head that it cannot be appreciated; and yet the fluid contents of the cranium prevent compression of the skull and make the engagement of the head impossible. The writer has seen one such case. Hydrocephalus should always be suspected if the head in labor remains above the brim, although the pelvis is normal in size and no good reason can be found for the failure of engagement.

The treatment of labor obstructed by hydrocephalus is puncture of the cranium with a perforator and evacuation of its fluid contents. A child with this disease deserves no consideration. After the reduction in the size of the head the labor may be left to the natural forces. If these prove insufficient, a cranioclast may be fastened to the skull and the child be extracted artificially. A cardinal rule in the treatment of these cases is to avoid attempts to deliver with forceps—a common error in practice, and one that has cost many a woman her life from ruptured uterus, from deep tears when the instrument slips, as it will, and from extensive sloughs after delivery.

If the pelvic extremity of the hydrocephalic fetus presents—as it does in almost a third of all cases—and if the head remains inaccessible above the superior strait, so that it cannot easily be punctured, the spinal canal may be opened, a catheter be passed through it into the cranial cavity (Van Huevel's method), and the fluid thus be evacuated (Fig. 376). Usually, however, there is no special difficulty or danger in the delivery of the after-coming head of a hydrocephalic infant. The force required for its extraction not infrequently ruptures the walls of the ventricles and converts the case into one of external hydrocephalus, or possibly drives the fluid out of the foramen magnum into the tissues of the neck and back, so reducing the bulk of the head as to permit its extraction. At any rate, the condition can scarcely escape the notice of the medical attendant, and a diagnosis is made before the lower uterine segment is dangerously stretched or ruptured.

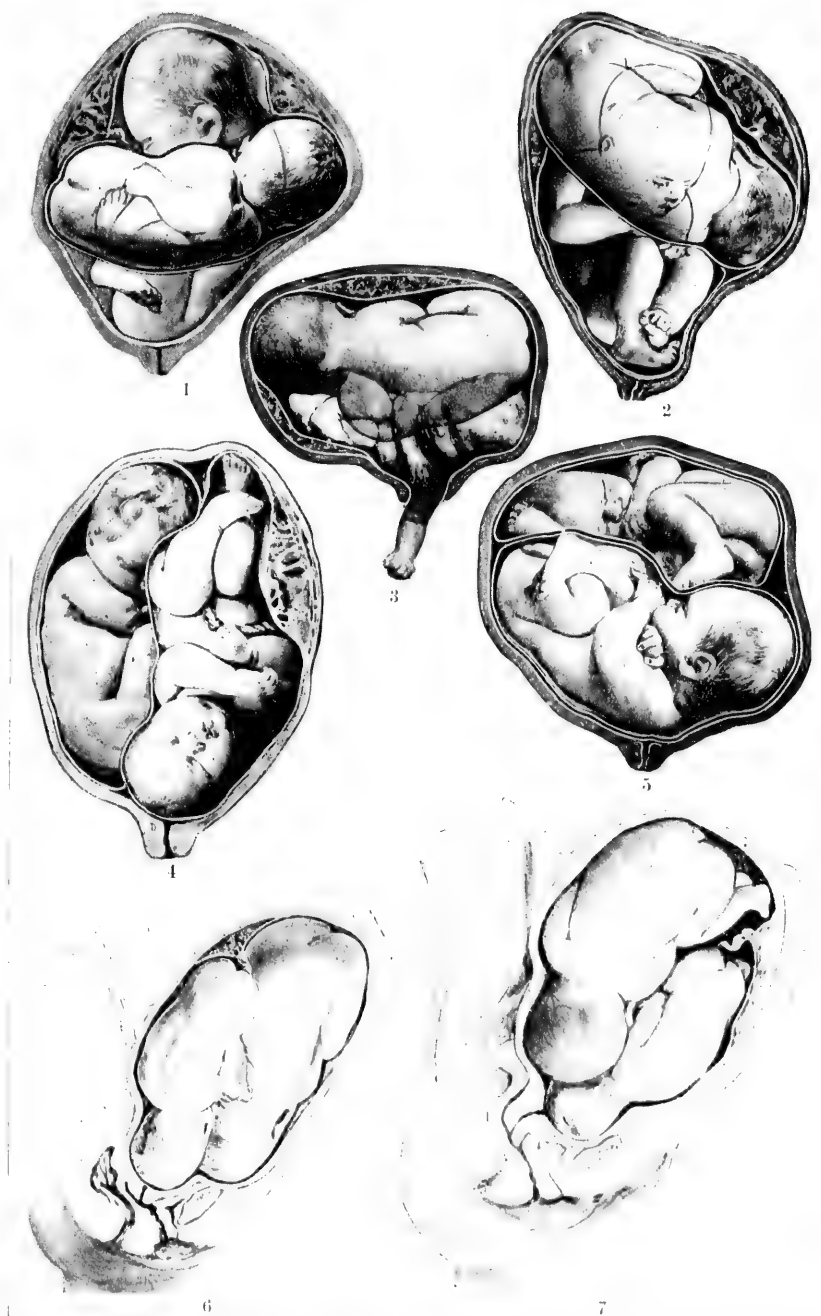
The difficulty in the delivery of a hydrocephalic fetus is not in direct proportion to the quantity of fluid in the ventricles and the size of the head. In cases of extreme distention the cranial vault is likely to rupture, while in moderate grades of hydrocephalus the quantity of brain-substance surrounding the ventricles and the strength of the brain-membranes forbid this means of spontaneous delivery.

Malpresentations and faulty positions (Pl. 39) include shoulder, face, brow, deviated vertex, and compound presentations. All but the last are considered elsewhere. By compound presentation is meant the presentation of two or more parts at the same time, as a head and a hand, a head and a foot, a hand and a foot, nuchal position of the arm, or the head and all four extremities.



1, 2. Nuchal position of arm. 3. Compound presentation (bifid). 4. Compound presentation (thrust). 5. Compound presentation.





1, 2. Twins, transverse and breech. 3. Twins, both transverse. 4. Twins, head and breech. 5. Twins, both transverse. 6, 7. Twins, both heads presenting.



A compound presentation is met with about once in 250 labors. It is usually a head and a hand. The following table is furnished by Pernice from 2891 births in the clinic at Halle:

Hand and head	26
Arm and head	8
Hand and umbilical cord	5
Both hands	4
Foot and hand	2
Two hands, umbilical cord, and foot	1
Face, hand, and cord	1

Kietz found in 7555 labors the foot and head presenting in twenty-three.²⁵

The cause of compound presentations is usually a lack of conformity in the presenting part with the pelvic inlet (as in malposition of the fetus), a head of abnormal size, a displaced uterus, twins, hydramnios, contracted pelvis, and anomalous shape of the uterus, etc.

In the *treatment* of compound presentations before rupture of the membranes an attempt should be made to overcome the difficulty by postural treatment. The woman should be placed on that side opposite the prolapsed extremity. After rupture of the membranes an attempt should be made to dislodge the prolapsed extremity and to restore it to its natural position. Version may, however, be required if this attempt fails, or even craniotomy if the child is dead. If the head and extremities present, and if the former is engaged, it is usually best to apply forceps and to disregard the prolapsed extremities. In the case of nuchal position of the arm an effort should be made to dislodge the latter, but it may be necessary to fracture it before the delivery of the child can be secured.

Multiple Births.—Twin labors are usually easy and uncomplicated (75 per cent.), but complications are more frequent than in single labors. Malpresentations are common (Pl. 40). The following table from Spiegelberg, based on 1138 labors, gives the combined presentations in the order of their frequency:

Both heads presenting	49	per cent.
Head and breech	31.70	" "
Both pelvic presentations	8.60	" "
Head and transverse	6.18	" "
Breech and transverse	4.14	" "
Both transverse . . . . .	.35	" "

It may be noted that a transverse position is found in 10.67 per cent. of cases. Mechanical difficulties in labor are frequent, the uterine muscle is usually weakened by overstretching, and there may be trouble in the third stage of labor in the delivery of the placenta. Some form of operative interference is demanded in about 25 per cent. of all cases.

In the majority of cases (79 per cent.) the interval between the delivery of twins is less than an hour. A longer delay than this indicates the likelihood of some obstruction to the birth of the second infant or a failure of expulsive forces.

Serious difficulty in twin labors may arise in one of three ways: Both

heads present at once, one a little in advance of the other, the second impacted in the neck of the first (Fig. 377); the first child descends by the breech, and the

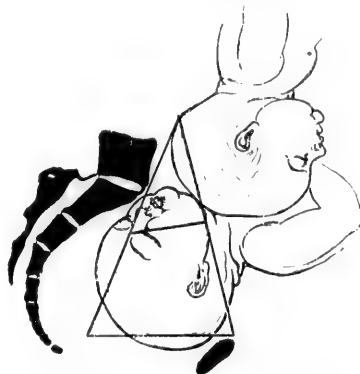


FIG. 377.—Impaction of heads in twin labor.

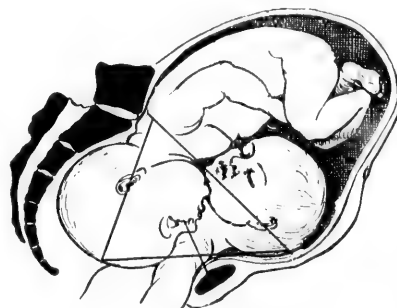


FIG. 378.—Locking of heads in twin labor.

head of the second child is caught by the chin of the first and pushed into the pelvis (Fig. 378); one child sits astride of the other, which is transverse. If both children should be found attempting to engage by the head in the superior strait at one time, one child should be retarded while the other is artificially extracted. If this is impossible, the first head should be extracted by forceps, the second be treated in like manner, and then the trunks should be delivered one after the other. Embryotomy is a last resort, but is scarcely ever necessary.



FIG. 379.—Entanglement of cords in twins (Winckel).

A coiling of the cords (Fig. 379) and their entanglement may be a source of difficulty and delay in unioval twins. It may be necessary to cut one or both cords between ligatures before the children can be delivered.

In case one child presents by the head and the other by the feet, both may come down together, and the two heads become locked in the pelvic entrance and canal. An effort may be made to push back the child presenting by the head. If this succeeds, the child presenting by the breech should be extracted immediately, for it is in imminent danger from asphyxia. It may be possible with forceps to pull the child presenting by the head past the body of its fellow presenting by the breech. Failing in these attempts, the child presenting by the breech will almost surely have died and there will be no pulsation in its cord. It should then be decapitated, whereupon the infant presenting by the head can be extracted without difficulty by forceps.

In any case of twin labor, as soon as the first child is born, and the cord, ligated with a double ligature, is cut, the attendant should immediately investigate the position and presentation of the second child. A neglect of this rule leads very often to the impaction of an unrecognized shoulder presentation in the second child, and its consequent death. If an abnormality is discovered in the presentation of the second child, it should at once be corrected. Then, after waiting perhaps half an hour, the amniotic sac should be ruptured, and ergot may be administered in a full dose to secure a speedy delivery, or, if the stomach will not retain it, the hypodermatic syringe should be used, for, the birth-canal having been dilated thoroughly, there is no obstacle to the birth of the second infant in twin labors, and consequently no objection to the employment of ergot, which not only hastens the conclusion of labor, but promotes subsequent contraction of the much-distended uterus, and so prevents postpartum hemorrhage. As a further precaution against this accident the fundus should be compressed for a long time after birth by the nurse.

There may be difficulty in the delivery of the placenta in twin labors. Commonly the children are born first and the placenta afterward. Their bulk may make expression difficult, and it is often necessary to make some traction upon the cords—first upon one and then upon the other—to determine which placenta will come first and to assist in its expulsion.

Occasionally one and rarely both placentae may be expelled after the birth of the first child. In a case of the writer's the placenta of the first child, prolapsing in front of the second, necessitated a difficult forceps operation for the extraction of the second. On account of the frequent and extensive anastomoses between the vessels of the placentae in unioval twins it is a necessary precaution to tie the cord of the first child with a double ligature and to cut it between the ligatures; otherwise the second infant might bleed to death.

The *prognosis* of twin labors is always doubtful. There are so many possible dangers for both mother and children that multiple labors must be regarded as distinctly pathological. Albuminuria in the mother is the rule in multiple pregnancies, and eclampsia is ten times more frequent than in single births.* There is a disposition to inertia uteri during and after birth from distention

* Of 627 cases of eclampsia, sixty-nine were multiple pregnancies (Winckel).



FIG. 380.—Twins, head and breech.

of the cavity, and consequently a likelihood of post-partum hemorrhage. Some operative interference or intra-uterine manipulation is called for in about 25 per cent. of cases, and this, in addition to the frequency of kidney insufficiency, predisposes to sepsis. Finally, there may be insuperable obstruction in labor if locked twins are not managed properly, and the woman may die of ruptured uterus or of exhaustion. The maternal mortality in the Budapest Maternity was four times as great as in the single births, and Kleinwächter's statistics give a mortality of 13 per cent. For the children there is greater danger than for the mother. Twin pregnancy is almost always prematurely interrupted, and even if it is not the children are, as a rule, under the normal size and weight. There is always the possibility that the development of one child at least will be seriously interfered with by the lack of room in the uterine cavity. Hydramnios of one sac and oligohydramnios of the other are not uncommon. In labor there are the frequent complications from malposition, operative interference, entanglement of or pressure upon the cords, and more rarely the engagement of both bodies at once in the pelvic canal. In Kleinwächter's and Kézmárszky's statistics the fetal mortality was nearly 40 per cent. Of 38 children in cases of locked twins, only six survived—a mortality of 84 per cent.

Cases are on record in which an extra-uterine fetus has obstructed the delivery of the intra-uterine twin. It has been necessary to make a vaginal incision through which the former was extracted before the latter could be born.

Death of the fetus during or before labor, followed by rigor mortis, has proven a source of obstruction in labor by the rigidity of the child and the consequent interference with the normal mechanism of its delivery, and especially of the shoulders and trunk.²⁶ Ankylosis of the large joints of the extremities may have the same effect to a less degree.

Labor Complicated by Abnormalities in the Fetal Appendages.—
Membranes.—If the membranes are too thin, they may rupture prematurely, and thus give rise to what is called a "dry labor," in which the birth-canal must be dilated by the hard, unyielding presenting part instead of by that conservative hydrostatic dilator, the bag of waters. Such labors are longer and more painful than the average, and there is a greater likelihood in them of lacerations in the cervix and a more frequent demand for an artificial termination with forceps. If the membranes are too thick, they rupture late, being preserved perhaps until the child's head presents at the vulvar orifice, or even until the complete escape of the head from the mother's body. In these cases the head and face are covered by the membranes as though by a veil, and care must be taken to free the mouth and nose quickly, that respiration may be instituted without interference. The membranes thus covering the head and face are spoken of as a "caul." It is possible for the whole ovum to be extruded unbroken at term. The writer has seen this occur as late as the seventh month, and, as stated, it is actually recorded at the full period of gestation.

Difficulties in labor may be encountered in consequence of an abnormality in the quantity of liquor amnii. If there is too little, the labor has the same

Clinical features as though there had been a premature laceration of the membranes. If there is too much liquor amnii, there may be inertia as the result of overstretching of the uterine muscle-fibres.

Umbilical Cord.—If the umbilical cord is too short, it may cause premature detachment of the placenta or may prevent the advance of the child. The *diagnosis* of a short cord in labor is always difficult. It may be suspected, however, if there is exaggerated pain at the placental site, marked recession of the head after each pain, and an obvious retardation of labor

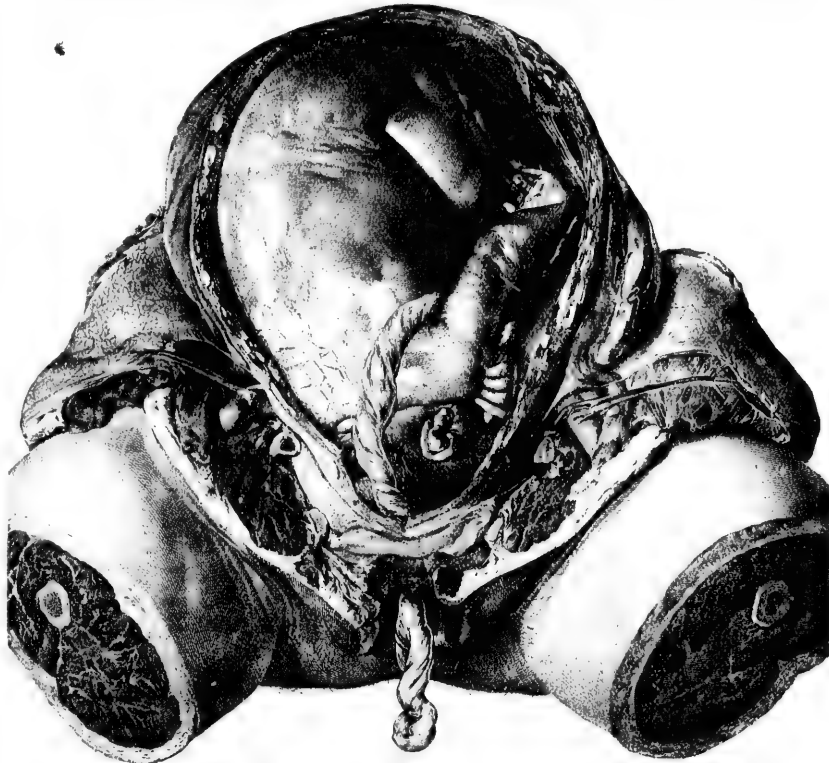


FIG. 381.—Umbilical cord, caught in the axilla, encircling the shoulder and prolapsed.

without other ascertainable cause. Forceps should be applied in such a case if the presentation is cephalic. If the cord is too long, it may possibly prolapse should there be other conditions in the labor favorable to such an accident; or it may be coiled about the child's neck, trunk, or extremities, and may consequently be fatally compressed during labor (Fig. 381).

Obstruction of a mechanical character in labor on the part of the placenta is seen only in placenta previa and in prolapse of the placenta. The placenta may be adherent as the result of syphilitic or other inflammation of the endometrium during pregnancy, and, becoming partially detached in the third stage,

may cause alarming hemorrhage. It is very commonly simply retained in the lower uterine segment or in the vagina, whence it may be expressed by the proper application of Credé's method. In some cases the atmospheric pressure obstructs the delivery of a retained placenta so effectually that it is necessary to hook one's finger over the edge of it, to allow the access of air behind it, before its expression is possible. Retention of the placenta may be due to its great bulk, as in twin placenta, or to tumors increasing its size. In such cases it may be necessary to extract the placenta manually.

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2. DYSTOCIA DUE TO ACCIDENTS AND DISEASES.*

1. ACCIDENTS TO THE UMBILICAL CORD.

The cord usually measures about 20 inches, but it may have twice or thrice that length, or may even be longer. In consequence of this increased length prolapse is liable to occur. Great length of the cord at least permits more or less numerous coils or "circulars" of the funis about the fetus or its members. In consequence of these circulars the cord may be shortened, or there may be a natural shortness of the cord. The cord has been known not to exceed 10 centimeters (4 inches) in length, but most generally its shortness results from its coiling around the fetal parts. This brevity, whether natural or accidental, interferes with labor, and may cause conditions more or less grave to the child and to the mother, for a ruptured cord, a detached placenta, or even an inverted uterus, may be among the accidents resulting from the anomaly. Complete absence of the cord has been observed, the vessels passing directly from the abdomen of the child to the adjoined placenta. The reason is therefore plain for including in a single group anomalies of, and accidents to, the cord.

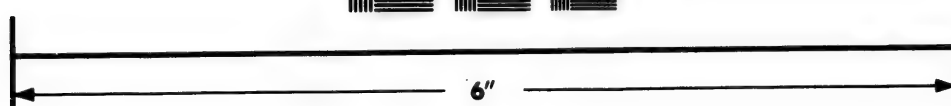
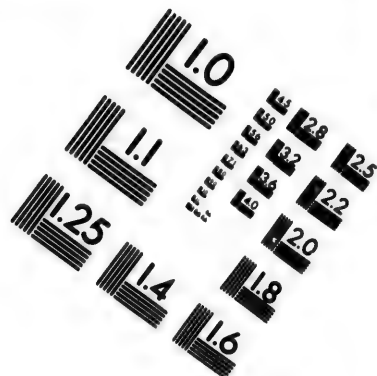
Prolapse of the Cord.—By prolapse is meant descent of the cord with, or in advance of, the presenting part of the fetus. The prolapsed loop may be felt mobile in the waters when the membranes are unruptured; or, the amniotic liquor having been discharged, the loop may be in the vagina; or, finally, it may be external to the vulva (Fig. 381). Thus there are three † varieties of prolapse, though some authorities describe the first variety as presentation of the cord. The second variety of prolapse may be met with though the first was not observed or even did not occur, the loop having suddenly been carried into the vagina by a free discharge of amniotic liquor. In most cases the two halves of the loop are in apposition, but in some cases the presenting part may intervene. Thus in presentation of the head one half of the loop may be on one side and the other half on the other side of the presenting part; or in presentation of the pelvis the cord may be between the thighs.

The frequency of prolapse of the cord is variously stated. According to Winckel, clinics give from 1 in 65 to 1 in 500; this accident is oftener observed in hospital practice than in private practice.

Etiology.—The essential cause of prolapse of the cord is want of correspondence between the presenting part and the lower portion of the uterus, for if the former fully occupies the space, there will be no room for the cord. Among causes that contribute to this accident are great length of the cord; the woman standing or sitting when the membranes rupture; an excessive quantity of amniotic liquor; smallness of the fetus; multiparity; implantation

* The superior figures (1) occurring throughout the text of this article refer to the bibliography given on page 644.

† The classification made by Jacquemier, *Manuel des Accouchements*, 1846, has been adopted.



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of the placenta in the lower portion of the uterus; marginal attachment of the cord; pendulous abdomen; plural pregnancy; the birth of a male; a complex presentation—as, for example, descent of a hand with the head; presentation other than of the vertex or the face; and, more important than any of these, narrowing of the pelvis. Kaltenbach¹ remarks that prolapse of the cord in presentation of the head occurring in a primipara should always excite suspicion of a narrow pelvis. Predisposition has also been mentioned as a cause, the accident having been observed in successive pregnancies; but, of course, to admit predisposition as a cause no other obvious cause must be present. Roper² has given a case in which the accident occurred in three successive pregnancies, but there was notable lessening of the conjugate. The prolapsed loop usually descends in front of one of the sacro-iliac joints or in front of the cotyloid cavity, and rarely directly anterior or posterior.

The diagnosis of prolapse of the cord can immediately be made if the membranes have ruptured and the loop is in the vagina, and still more readily if the cord is external to the vulva. A mistake in either case would seem impossible; but with the membranes intact and with the pulsation absent the diagnosis is more difficult. The obstetrician feels with his fingers, in the interval of uterine contraction, a soft, floating body, the thickness of a finger; he can define it as the cord by hooking his finger in the loop and pressing it against the presenting part or against the uterine wall: if pulsation is detected, there is no possibility of doubt. Winckel³ called attention to the fact that if, in auscultating the fetal heart, the sounds become slower, there is probable pressure upon the cord, and an examination may lead to the discovery of prolapse of the cord.

Prognosis.—Danger to the mother is exceptional in prolapsed cord. In consequence of the cord being stretched tightly over the head of the child, or, in pelvic presentation, of the child being astride of the cord, there may be such an accidental shortening of the cord that detachment of the placenta with hemorrhage results. Moreover, the operations which the prolapse may require in its treatment—manual or instrumental reposition, podalic version, or extraction with the forceps—are not to be regarded as trivial matters and without peril to the mother, although that peril is slight. The danger to the child, however, is very great. Probably it is correct to give the mortality as not less than 40 per cent.

The danger to the fetus is compression of the cord, death resulting from asphyxia. The danger varies also with the presentation, being greatest in that of the head, but much less in shoulder or breech presentation. Early prolapse is more unfavorable than late prolapse. If the cord is implanted upon the margin of the placenta and the placenta occupies a low position in the uterus, or if the insertion is velamentous, or the pelvic contraction (a factor in causing the disorder) is great, the prognosis is more unfavorable than when opposite conditions are present. Finally, the amount of the prolapsed portion and the part of the pelvis in which it descends should be considered.

Treatment.—If it is certain that the child is dead, a purely expectant plan of treatment is indicated in prolapse of the cord. The diagnosis of death, however, should be made, not solely from finding the cord pulseless, for pulsation may be absent in it for several minutes and yet the child be alive, but by careful and repeated abdominal auscultation. Again, if the prolapse is simply a complication of placenta prævia or of shoulder presentation, the treatment of the essential disorder is first in importance, and it may prove best, too, for the complication. In ordinary cases restoration of the prolapsed cord, if this be possible, is the obstetrician's first duty.

In the first variety or degree of prolapse, frequently called "presentation of the cord," the patient should be recumbent and great care should be taken to avert early rupture of the membranes. It will be better for the patient to lie upon the side opposite to that on which the prolapse occurs, and her head should be low. Hicks advises that the patient assume the knee-elbow position and that entrance of air into the vagina be secured.

In the second degree of prolapse—namely, a loop of the cord in the vagina—if the pulsation is good, the cord being at the side of the head, in front of one of the sacro-iliac joints, and the descent of the head being rapid, so that spontaneous delivery will speedily occur, it is better to wait, interference with forceps, for example, being determined by the pulsations in the cord becoming feebler or ceasing. La Motte, whose rule in cases of prolapsed cord was podalic version,⁴ gives a graphic account of one of his cases ending favorably for both mother and child. He did not discover that the cord had descended until he found it in the vagina, and the uterine action was so great and constant that he could not attempt to turn. In his *Reflexion* he observes that probably his "ignorance was the safety of the child."

If speedy delivery, either spontaneous or instrumental, is impossible, reposition of the cord is indicated. This replacement is postural, manual, or the two combined. Instrumental reposition might have been included, but there is no instrument equal to the hand for this purpose, hence reference to the various repositors will be omitted. If the postural method is employed, the patient is put in the knee-elbow position. The hand may also be used at the same time, as advised by Kaltenbach, but it is preferable, if manual assistance be required, that the patient should be upon the side, for then only can anesthesia fully and satisfactorily be employed. Braxton Hicks gives the following directions: "The anesthetic having been given, the patient remaining in the ordinary lateral obstetric posture, one hand is placed over the abdomen and the position of the child's head is made out. This may be done by separating the thighs and passing the hand, preferably the right, between them. The left hand, having its back greased, is passed into the vagina, and, gathering the funis together, carries it past the head, which is at the same time pressed sufficiently aside. When the funis is restored the external hand presses the head down, and the fingers inside receive it and adjust it in the os. Six or more labor-pains having occurred, the internal hand may be removed, although it might have earlier been removed, and reintroduced to feel

if the funis is still up. The patient can then be placed on her back, while the outer hand is kept a little longer to secure the adaptation of the lower uterine zone to the head."⁵

The writer has two remarks to make in regard to the method suggested by Hicks. The use of the left hand for replacing the cord, the patient being upon her left side, is suitable if the prolapsed loop of cord be upon the right side of the pelvis, but if the funis has descended upon the left side, then the woman should be in the right lateral position, and the right hand is the preferable one for introduction, while the left hand is used externally. Further, when the cord is restored it is well to hook it over some part of the child, the knee, for example, or pass it above the chin: the method of placing the cord over one of the lower limbs to prevent its again falling was probably first recommended in 1786 by Croft.⁶ By whatever method the cord has been replaced, prolapse is very liable to recur. So great, indeed, is this liability that some classic writers on obstetrics have compared its restoration with the task of the Danaides and with that of Sisyphus.

Manual reposition having failed, podalic version best meets the emergency of prolapsed cord. Spiegelberg⁷ takes the ground that it is not well to spend too much time in trying to replace the cord, such efforts in themselves disturbing the umbilical circulation, and perhaps injuriously affecting the subsequent course of the uterine contractions.

After version the question of immediate delivery will be determined by the condition of the fetal circulation, for if this remains good it is better to leave the expulsion of the child to the forces of nature. Winckel advises, in shoulder presentation complicated by prolapsed cord, immediate extraction after version, because the latter can hardly be effected without great pressure upon the cord. If in pelvic presentation the child is astride of the cord, an effort should be made to draw down enough of the loop to permit its being passed over one thigh: if the loop does not permit this lengthening or if there is dangerous stretching, it is better to divide the cord.

Coils or Circulars of the Cord.—The cord encircles the fetus once in about every six cases of delivery. These coils or circulars—adopting the equivalent of the French *circulaires* as applied to this condition—are much more frequently about the neck of the fetus, but they may be around the body or around the members. There may be one or several circulars; for example, the cord, while usually around the neck once or twice only, may encircle it six, seven, or even eight times. The optimism of Jacquemier led him to believe that *circulaires* were a wise provision against prolapse of the cord. This anomaly is generally associated with great length of the cord, but in some cases the length is normal, and in a very few it is less than normal.

Etiology.—Winckel⁸ mentions as causes of circulars a long cord, a large quantity of amnial liquor, the yielding uterine walls of multiparæ, marginal and velamentous insertion of the funis, and smallness of the child. Of course the movements of the fetus are the immediate cause of the anomaly. Chantreuil observes⁸ that experience does not confirm the opinions of Michgorius,

Mme. Boivin, and others, who attribute circulars to the excessive movements of the mother.

The injurious results of circulars, so far as labor is concerned, usually arise from brevity of the cord—a brevity which is then called “accidental,” though by many the adjective “relative” is applied to the condition to distinguish it from “absolute” brevity. The accidents resulting from shortness of the cord will be considered in the next section.

Natural or Accidental Shortness of the Cord.*—By natural shortness of the cord is meant that the length measured from the umbilicus to the placental insertion is insufficient to permit expulsion of the child without rupture of the cord, placental detachment, or uterine inversion. Accidental shortness, usually arising from coils about the neck of the child, is similarly defined, except that the point of the fetus from which the measurement is taken is no longer the umbilicus, but is the neck.

It is evident that the length of the cord will vary, in case of absolute brevity, with the degree to which it can be stretched, and in accidental brevity with this elasticity, and also with the tightness of the coils caused by the strain. Further, the point of placental attachment, either in the upper or the lower part of the uterus, and the insertion of the cord, whether marginal or central, must also be taken into consideration. Matthews Duncan⁹ assumed that “it is impossible to make a quite exact statement of the length of any cord while proving itself a cause of difficult labor.” Lamare says, accepting the statement of Negrier that the length of the genital canal at the time of expulsion of the fetus is 22 centimeters ($8\frac{3}{4}$ inches),¹⁰ that true brevity begins at 25 centimeters (10 inches), and that only below this length does the cord inevitably cause accidents.†

Shortness of the cord does occur, notwithstanding the scepticism of Dewees,‡ though the instances of it are infrequent. The consequences of this condition are painful, protracted labor; impossibility of spontaneous delivery; there may be fatal pressure upon the cord, or it may be torn and there may be hemorrhage from detachment of the placenta, and even inversion of the uterus. Rigby gives an instance of a cord which was only 2 inches long being torn at its placental insertion, the delivery being spontaneous. Kales¹¹ delivered with the forceps in a case in which there proved to be accidental shortening of the cord. On making traction during a pain he found there then occurred a notable depression at the fundus of the uterus, the depression disappearing when the traction ceased—one of the signs of this anomaly, according to some authorities, although denied by others. Werder¹² reports

* Most authors use the terms *absolute* and *relative*, but the writer thinks that the adjectives which he here employs are preferable.

† Kaltenbach (*Lehrbuch der Geburtshilfe*, 1893) states that if the placental insertion of the cord is at the fundus 35 centimeters is too short, while in deeper insertion 20 centimeters is sufficient.

‡ “I shall not positively deny the existence of such a condition; but I must say I have never seen an instance, and also that I entertain strong doubts of its possibility.”—*Compendious System of Midwifery*, 8th ed., Philada., 1837.

a case in which, the child being delivered with forceps, the cord was found torn at the umbilicus, and with it a large circular flap of skin: the cord was less than 4 inches long. Felkin¹³ narrates a case of spontaneous delivery in which the cord, $5\frac{3}{4}$ inches in length, was torn and the placenta was expelled with the child, severe hemorrhage occurring. In a second case of accidental shortness of the cord, there being five coils about the neck and one around the body, the delivery was spontaneous and inversion of the uterus occurred. Dyrenfurth of Breslau,¹⁴ in a case of hydrocephalus, punctured the head and delivered it with the cranioclast; there was then delay in extracting the shoulders, and when this difficulty was overcome and the labor was ended it was found that the cord, which measured but 3 centimeters, was torn half a centimeter from the umbilicus. Malgouyre had a patient in labor at term, and immediately after the rupture of the membranes the child and placenta were expelled, the cord being found to be 2 inches and 8 or 9 lines in length. In a case reported by Leroux¹⁵ the umbilical cord was so short after the escape of the fetus that the umbilicus was closely applied to the vulva, and the child could not be taken away until the placenta was expelled.

It has been established by Negrier¹⁶ that if there be accidental shortening of the cord because of a loop around the neck, partial delivery may occur, the child breathing, and then, unless suitable assistance be rendered, the child will be strangled from constriction by the cord. Mackness,¹⁷ in a case of placenta previa, after performing podalic version, bringing down one foot, and finding the hemorrhage not arrested, brought down the other foot; after extracting the body further progress was arrested because of the cord passing between the child's legs. It was necessary to cut the cord before the head could be delivered.

Diagnosis.—The signs usually given of brevity of the cord are severe pain at the place of the supposed placental attachment; depression of this part during a uterine contraction or when traction is made with the forceps; marked recession of the head in the interval of contractions, this recession being greater than can be attributed to the resistance and elasticity of the lower part of the birth-canal; irregular discharges of blood; and arrest of pains. Napier¹⁸ regards uterine inertia as a more important diagnostic sign than retraction of the head. Dr. King,¹⁹ who has made several important contributions on the subject, states as a characteristic sign that the patient has a persistent desire to sit up.

Coils about the body may be known in some cases by auscultation, in still rarer cases by abdominal palpation. Haake was the first (in 1865) to discover coils around the neck by rectal touch. But the only certain way to ascertain that there is shortness of the cord is to feel it and actually to know that it is tight and stretched. This may be done in breech presentations, when the child is astride of the cord or after the breech is born, by passing one or two fingers up to the umbilicus, and finding, by pulling toward the placental end, the cord so taut that it is impossible to draw any part of it down. In presentation of the head, after expulsion as far as the umbilicus, a similar method

of examination may also be employed. Hicks⁹ narrates a case in which he made the diagnosis of short cord; after the delivery of the breech he had to divide the cord before the rest of the child could be born. The cord proved to be but 4 inches long.

Treatment.—In regard to the treatment of shortness of the cord but little can be said. Roederer, and many obstetricians since his day, urged the importance of pressing the uterus downward, the obvious benefit of which, of course, is to bring the placental attachment nearer the fetus. King¹⁹ seeks to accomplish the same object indirectly by having the woman "take a kneeling, sitting, or squatting position, or by so elevating the shoulders that she is placed midway between lying upon her back and sitting." In connection with Dr. King's method the following citation from Denman²⁰ is of interest:

"If the child should not be born, when we have waited as long as we believe to be proper or consistent with its safety or with that of the parent it will be requisite to change her position, and, instead of suffering her to remain in a recumbent one, to take her out of bed and raise her upright to permit her to bear her pains in that situation; or, according to the ancient custom of this country, to let her kneel before the bed and lean forward upon the edge of it; or, as is now practised in many places, to set her upon the lap of one of her assistants."

It is better that the child should be delivered by pressure, fetal expression, than with the forceps. Instrumental delivery is the last resort. Of course, when a short cord is discovered, which will usually be only after partial expulsion of the fetus, the cord should be divided. When, in accidental brevity of the cord, the strain is not relieved by cutting the cord or by removing one or more of the coils over the head, the child is usually delivered by what Duncan²¹ terms a movement of spontaneous evolution: "in consequence of the strain upon the cord the fetus so revolves that its anterior surface is brought to look forward." Duncan adds that in cases of coils about the neck this revolution is in a direction to undo partially the encircling, and thus to lessen the strain upon the cord, and that this part of the evolution may artificially be performed to aid the delivery.

Rupture of the Cord and of its Vessels.—The cord may be torn or there may be rupture of one or more of its blood-vessels; in other words, there may be complete or partial rupture. Some illustrations of ruptures of the cord have been given in the preceding section. This accident occurs most frequently in consequence of absolute or accidental shortness, omitting those cases in which the obstetrician tears the cord in an effort to extract the placenta. The strength of the funis has been the subject of experimental study. The experiments of Duncan and Turnbull²¹ show that the average resistance of the cord to a strain on it is eight and a quarter pounds, the weakest cord yielding to five and a half pounds, and the strongest to fifteen. The experiments of Lamare⁸ prove that in order to rupture a cord of 50 centimeters by a weight falling 25 centimeters, it is sufficient that this weight may in the mean equal 1500 or 2000 grams, and it may even be as small as 660 grams. He has shown also

that the living cord—that is, the cord having its vessels filled with warm water—breaks with a slightly less force than the dead cord.

It is evident that, as has repeatedly been proved, the cord may be torn simply by the weight of the child, expulsion taking place while the mother is erect or even semi-erect. Moreover, there are instances of the cord giving way in childbirth while the woman was lying in bed. Spaeth's case * illustrates this: In a primipara, the first stage of labor being tedious and the second stage lasting but half an hour, a violent contraction occurred while the midwife was placing a cushion under the patient's hips, and the child was driven out a distance of 50 centimeters from the genital organs. The cord, thick, gelatinous, and friable, was broken: it was 30 centimeters long, and the rupture was in its middle. Budin²² has given a similar case: The patient, a secundipara, made violent expulsive efforts, and the child was rapidly expelled. The cord, which encircled one of the thighs of the child, was torn 10 centimeters from the umbilicus: its entire length was 42 centimeters. Budin²³ has also given a case in which the weight of the placenta, which was suddenly expelled and fell to the floor, ruptured the cord near the umbilicus. The attendant, while waiting for the pulsations in the funis to cease before ligating, was surprised by the abrupt discharge of the placenta from the genital canal.

In several instances the cord has been ruptured at the umbilicus by the attempt to remove circulars from the neck.

Cases are recorded of partial rupture, the tear involving only the vein or the vein and one of the arteries: the tear being also in the sheath of the cord, the hemorrhage is external, but when the sheath is entire the blood may form a hematoma of the cord. McDougall²⁴ found in the cord, 2 inches from the umbilicus, a collection of blood the size of a hen's egg. Kirkpatrick²⁵ recorded a very remarkable case of thrombus in the cord: "The funis formed a loop the sides of which were adherent to one another, and in consequence of the pressure on the curve of the loop during labor a clot formed and the circulation stopped in the funis." Hamill²⁶ reported a case of fatal hemorrhage from a large branch of the umbilical vein running across the fetal surface of the placenta, a considerable mass of coagulated blood being found beneath the amnion. Velpeau²⁷ attributes ruptures of the blood-vessels to disease causing dilatation, "small aneurysmal or varicose pouches," and he states that he has "seen these dilatations torn at term, and communicating with a large clot which covered a part of the placenta and which had not ruptured the amnion."

In velamentous insertion of the cord, while, according to Winckel, 18 per cent. of the children perish from asphyxia resulting from compression of the vessels of the cord, a still larger proportion die from rupture of these vessels. Spiegelberg states that occasionally the obstetrician ruptures the cord while performing version, and even oftener during extraction. It is established that the cord ruptures more frequently at the fetal than at the placental end, and also that "spirals and vascular anomalies are weak parts, and the cord is peculiarly liable to tear at these points." Hemorrhage is much less likely to occur

* Quoted by Lamare: *Klinik der Geburtshilfe und Gynäkol.*, 1885. Chiari, Braun, and Spaeth.

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from a torn than from a cut cord. In 183 cases of torn cord collected by Klein there were twenty-one in which the cord was ruptured at the umbilicus, and in none of them was there bleeding. Nevertheless, in exceptional cases of ruptured funis there may be considerable bleeding both from the fetal and from the placental end.

Treatment.—The treatment of ruptures of the cord is chiefly prophylactic. Remembering the causes of this accident, the obstetrician will endeavor to avert them, and he will thus prevent the patient from being delivered in other than a recumbent position, unless in quite exceptional cases, and he will not permit too rapid escape of the fetus. When the cord is accessible to touch and is so tense that tearing is threatened, he will divide it; furthermore, he will prefer to sever the coils about the neck of the child, rather than to use force for the removal of one or more of the coils. In velamentous insertion of the cord he will delay rupture of the membranes as long as possible, and if one or more of the vessels should be torn, he will deliver the child as soon as possible. In case the child is born and the cord is found torn, ligation is advisable even though no hemorrhage be present. As has been stated, almost all tears at the umbilicus do not bleed, but should they do so, the vessels are to be drawn out with a tenaculum and tied. This method was successfully employed by Braxton Hicks.

2. DYSTOCIA DUE TO HEMORRHAGE.

Placenta Prævia.—If the placenta, in whole or in part, be implanted in that portion of the uterus which must be dilated for the passing of the child, it is called "prævia." The lower segment of the uterus in pregnancy is half of a spheroid; in labor this hemispheroid must be changed into a canal or hollow cylinder having a diameter of about 11 centimeters ($4\frac{1}{2}$ inches). By the lower segment of the uterus is meant that portion bounded below by the internal os; its upper boundary is from $2\frac{1}{2}$ to 3 inches above, measuring along the uterine wall. In this lower segment occur the pathological phenomena of placenta prævia.

Hegar²⁸ in 1863 stated that too extensive formation of the serotina may cause the placenta to project into the area of expansion of the uterus. In 1890, Hofmeier²⁹ concluded from the examination of the uterus of a woman dying in the fifth month of a

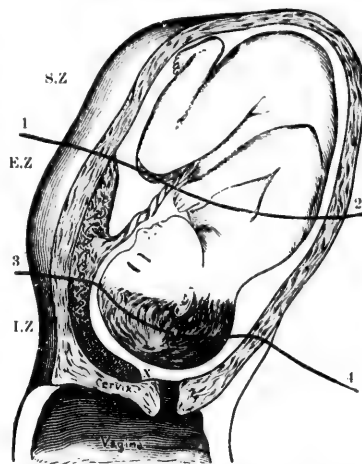


FIG. 382.—Partial placenta prævia. The uterus is divided into three zones: thus, 1, 2, is the line which marks the boundary between s.z., the superior zone, and E.z., the equatorial zone; 3, 4, is the line ("Barnes' boundary-line") which marks the limit between the equatorial zone, E.z., and the inferior zone, I.z. X is the prævia flap of the placenta, upon which the head rests (Barnes).

twin pregnancy that in "most if not all cases" placenta prævia originated from the development of the placenta within the reflexa of the lower pole of the ovum.



FIG. 383.--Placenta prævia in pregnancy with twins (Hofmeier).

Figure 383 represents admirably this view. Upon examining the illustration it will be noticed that a part of the reflexa upon which the placenta has formed is not yet united with the vera. Kaltenbach³⁰ states that "by preparations from early periods of pregnancy Hofmeier and the author have proved that in placenta prævia the development of the placenta takes place within the reflexa of the inferior pole of the ovum." The under surface of the presenting placenta is covered with smooth reflexa which later is united with the opposite vera.

The explanation of the origin of placenta prævia given by Hofmeier and Kaltenbach has been accepted by many obstetricians, among whom may be mentioned Olshausen and Martin; but there are some who dissent—for example, Ahlfeld, Winkel,* Berry Hart, and Gottschalk.³¹ Hart, in expressing his dissent, gave the following statement: "I must now state the view I advocate for the occurrence of placenta prævia. It is that of primary implantation of the impregnated ovum low down, or even over the os internum. The forcible objection that Kaltenbach urges against this view seems to me not quite valid. He holds that the small ovum would pass into the cervical canal and be lost. We must remember, however, that the hypertrophied and folded decidua there will practically obliterate the os internum, and thus implantation over it may occur. But why should such a low implantation happen? We

* Winkel remarks, referring to the views of Hofmeier and Kaltenbach: "Ahlfeld has justly disputed the correctness of this explanation, and from a case in which the placenta was entirely situated in the lower uterine segment has given ground for the old opinion of the primary grafting of the ovum in the inferior third of the uterine cavity" (*Lehrbuch der Geburtshilfe*, 2d ed., 1893).

only know that it is more apt to occur in cases where the mucous membrane has been unhealthy. The hypothesis I would advance, but merely as an hypothesis, is that the human ovum can graft only on a surface denuded of epithelium, and that thus it does not graft in the Fallopian tube, but in some part of the uterine cavity where the epithelium has been removed by menstruation. If, then, the ovum does not meet with the connective-tissue surface until it has passed low down in the uterine cavity, some form of placenta prævia will happen."

Dr. Robert Barnes first announced in 1847 his theory of placenta prævia, and he has made several contributions to the subject since, the most recent of these being a paper read by him in 1892 before the International Congress of Diseases of Women and Obstetrics, in Brussels. In justice to one of the most eminent and able obstetric writers and teachers, as well as in justice to the theory itself, which certainly was an important advance, and from the fact that the practice founded upon that theory is upheld by some obstetricians, prominent among whom is Murphy of Sunderland,—the latest public exposition of his views is here presented. The paper referred to being in French, a translation of a part is here presented. Dr. Barnes, after having stated that his theory is represented in Figure 382, proceeds as follows:

"It is seen from the illustration that the uterus is divided into three zones:

- (1) The superior or fundal zone;
- (2) The equatorial or middle zone;
- (3) The inferior zone.

The superior zone is separated from the equatorial by an imaginary line (1, 2) which may be called the 'superior polar circle.' This line, it is true, has not been anatomically demonstrated. But it serves to mark a distinction, which I believe real, between the characters of the superior and equatorial zones in their relations to the placental attachments and to hemorrhage.

"The equatorial zone is separated from the inferior zone, otherwise called the inferior uterine segment, by the line 3, 4. This line is the line of demarcation of Barnes, Barnes' boundary-line (1847-1857). This line was called 'the internal os of Braune' in 1872; it became the 'ring of Bandl' in 1876; and later, the 'contraction-ring' of Schroeder. It may also be called the 'inferior polar circle.'

"The superior zone (s. z.) is the seat of fundal placenta; it is the safest region of attachment. The equatorial zone (E. z.) is the seat of lateral or equatorial placenta. The lateral placenta may give place to that form of hemorrhage called 'accidental;' nevertheless, the equatorial zone may be considered as site of attachment normal and safe. This security is still greater when the placenta is attached in part in the superior zone and in part in the equatorial zone. The danger begins when the placenta is attached in part in the inferior zone—that is, when there is partial placenta prævia. The portion of the placenta which encroaches upon the inferior zone (I. z.) is liable to

premature separation. Complete placenta prævia, called also *placenta prævia centralis*, is found when the entire placenta or the greater part of it is attached in the inferior zone and covers the internal os.

"In the last case the gestation would be, justly speaking, an ectopic gestation (or out of place), for the ovum, or an important part of it, is developed in the inferior zone of the uterus, a part which is not designed by nature for this function. The curved line traced in the inferior zone marks the position of the fetal head. The line of demarcation (3, 4) corresponds almost exactly

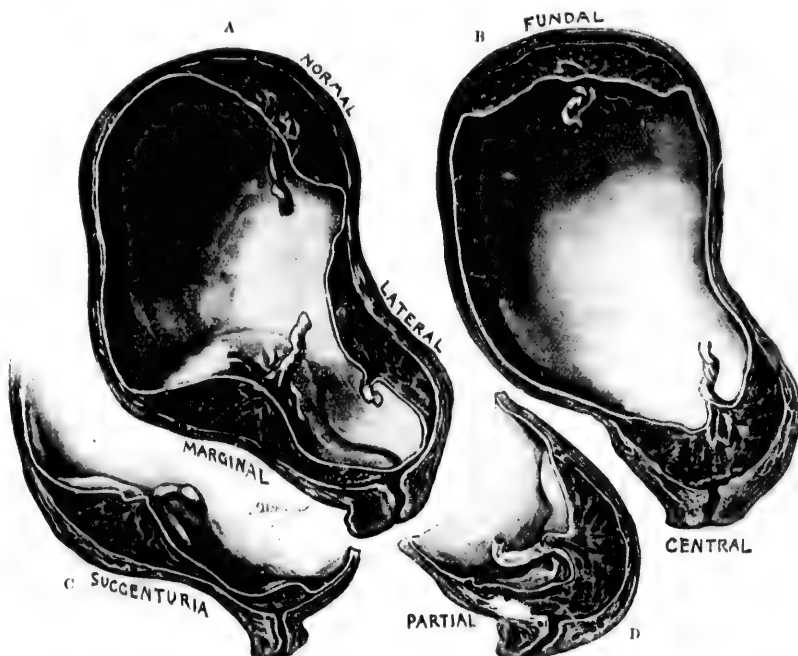


FIG. 384.—Varieties of placenta prævia: in A there are seen the normal, lateral, and marginal implantation; in B there are represented the implantation of the placenta at the fundus, which is rare, and implantation over the internal os; in C lateral implantation and that of a cotyledon immediately over the internal os; and in D partial implantation.

with the equator of the fetal head, and often it nearly corresponds with the entrance of the pelvis."

Varieties of Placenta Prævia.—The accompanying illustration (Fig. 384) shows different forms of placental implantation in the lower portion of the uterus, and the names applied to them, and also implantation at the fundus and at the fundus and side. Some confusion has arisen from giving so many varieties, and from differences in the application of terms designating them. Thus, one author calls that "partial" which another names "lateral," illustrating the ambiguity which comes from what Lord Bacon spoke of as "the unsteady use of words." The writer thinks it better, as Schroeder, Budin,

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and some others have done, to make but two varieties, *complete* and *lateral*. By complete placenta prævia is meant that condition in which the internal os is entirely covered by placenta. It corresponds with what many others have called "central implantation of the placenta;" that is, the centre of the placenta is supposed to be directly over the internal os. Pinard³² stated that in 15,000 accouchements he never met with the insertion centre for centre, consequently he has the right to say that this variety is exceedingly rare. Lateral implantation of the placenta includes those cases in which the great mass of the placenta is at the side of the uterus, a margin more or less near the internal

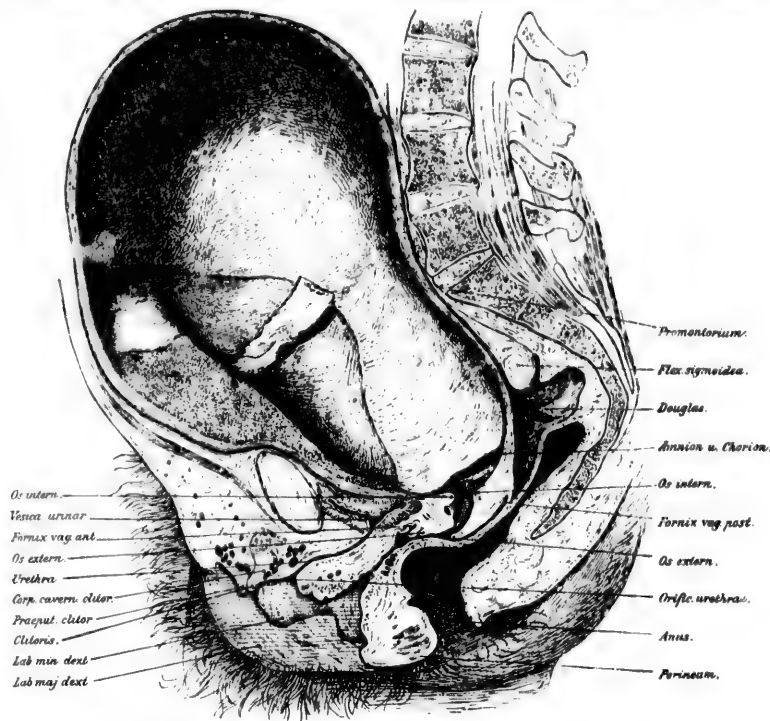


FIG. 385.—Placenta prævia: child removed, placenta remaining (Winter).

os; indeed, in some cases the margin may partially extend over the os. The lateral variety is much the more frequent.

Figure 385 shows a not infrequent condition, a single cotyledon over the os, while the great mass of the placenta is at the side: the first is known as placenta succenturiata.

Authorities generally agree that lateral is much more frequent than complete or central placenta. Nevertheless, Trask³³ gives 169 of the complete to 88 of the lateral, and Müller's statistics, which include those of Trask, show a slight predominance in favor of the complete variety. Read's statistics³⁴ show a

similar result. Unfortunately, in many of the cases given by Read there is a failure to state the placental presentation, and some others are described as "almost complete" or "nearly complete," and hence uncertain conclusions only can be made. Müller has shown that in complete placenta prævia the smaller lobule was situated at the left in thirty-seven out of 56 cases. In

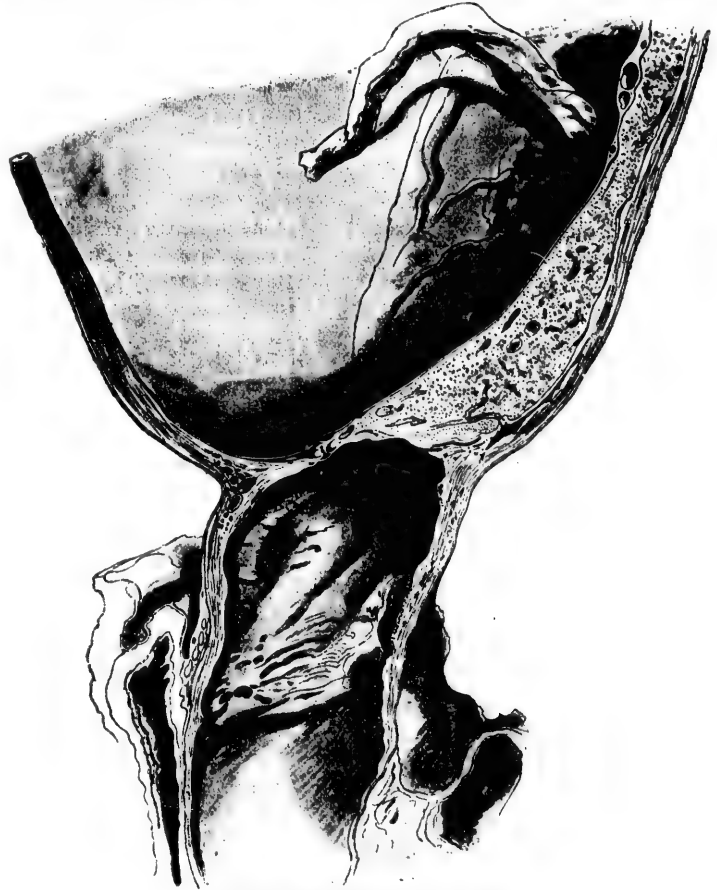


FIG. 386.—Partial placenta prævia (Ahlfeld).

lateral placenta prævia the placenta is in 50 cases at the right side to 31 at the left side. As will be seen, there is a correspondence between these results.

Frequency.—The proportion of cases of placenta prævia to the entire number of deliveries is usually given as 1 to 1000, 1 to 1500 (Winckel), and 1 to 1500 or 1600 (Kaltenbach). Pazzi³⁵ gives the proportion of 1 in 748. As illustrating how misleading limited statistics may be, we quote the statement of Townsend³⁶ as to cases of placenta prævia in the Boston Lying-in Hospital: In the last twenty years there were 28 cases of placenta prævia in

6700 deliveries. Thus there was 1 case of placenta prævia in 239 labors, or more than 4 in 1000. Of course, as Townsend remarks, there are more cases of this anomaly in hospital than in private practice, but still such a large proportion as he found is not the expression of a general truth. No age is exempt, for placenta prævia has occurred in a girl of thirteen years and in a woman of fifty. It is most frequent from thirty to forty years, for out of 248 cases 127 of the subjects were in that ten years (Müller).

Anomalies of the Placenta when it is Prævia.—The placenta is not oval, but is irregular in form; the prævial placenta extends over a larger surface, but is thinner, than the placenta having a normal site. A placenta succenturiata is not infrequent, or, again, the placenta may be composed of two lobes, and the bridge of tissue connecting these lobes may be directly over the os; hence an error in diagnosis is possible. The form of the placenta presents other varieties.³⁷ Thus it has been found in the shape of a half-moon or a horseshoe, or it is pyriform or cordiform; Gilroy³⁸ described one as lozenge-shaped, the cord being attached to one of the angles.

In placenta prævia there are frequently abnormal adhesions between the placenta and the uterine wall. Müller found such adhesions in fifty-four out of 142 cases, and Sabarth of Reichenbach in seven out of 14 cases. This condition may cause more or less serious delay and difficulty in the third stage of labor, and of course it gives a certain liability to infection. The insertion of the cord in many cases is marginal and sometimes is velamentous. Depaul³⁹ directed attention to the fact that the membranes in placenta prævia seem thickened as if infiltrated, and, further, that the chorion presents externally quite characteristic rugosities which alone suffice, even when the placenta cannot be felt either by its surface or at its border, to authorize one in affirming that the placenta is near.

Causes.—Spiegelberg⁷ states that previous abortions predispose to placenta prævia, and that it is more frequent in the poorer classes, possibly owing to hard work at the beginning of pregnancy, and still more to the subinvolution of the uterus which is so common in this class. So far as the first statement is concerned, it seems to the writer that both abortions and prævial placenta should be attributed to a common cause, a diseased condition of the endometrium. The accident is more frequent in multiparæ than in primiparæ—two- or three-fold (Winckel)—and according to Müller³⁷ 85 per cent. are multiparæ. Anomalies of the uterus, such as uterus *bicornis* and *unicornis*, cancer and myoma of the uterus, relax-

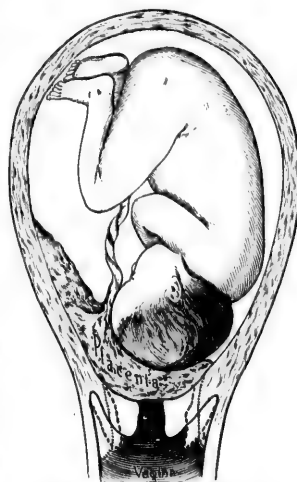


FIG. 387.—Partial placenta prævia, vertex presentation: the os beginning to dilate (Lusk).

ation of the uterine walls, opening of the oviducts in the lower part of the uterus, as in two cases reported by Ingleby, and, more important than most and more frequent than any of these, endometritis with hypersecretion, are causes of placenta prævia.

Osiander⁴⁰ believes that lying on the back favors insertion of the placenta at the fundus, lying upon one side favors a lateral attachment, and standing



FIG. 388.—Central placenta prævia, the os partly dilated (Hunter).

or sitting favors implantation over the os; hence he considered lying on the back or on one side, continued some time after copulation, as necessary for a fortunate situation of the ovum. Stein and others attribute the origin of placenta prævia to the specific gravity of the ovum. Müller states that others accuse conception during menstruation or while the uterus has a more vertical position, thus coitus while standing, as a chief ground.

In 1874, Angus Macdonald⁴¹ reported a case of twin pregnancy, the fetuses being transverse and each placenta presenting at the internal os. He regarded placenta prævia with twins as a very rare anomaly, and asserted that "the expectation of the concurrence of twins with placenta prævia is only 1 in 44,500 cases of labor," and that, of course, the probability would be much less with both placentæ presenting. Müller found it rare in plural pregnancy, but Barnes has spoken of it as not uncommon, and Winckel states that plural pregnancy predisposes to placenta prævia, the accident in his experience being relatively four times more frequent in plural than in single pregnancy.*

Reamy⁴² suggests that placenta prævia may originate in sexual intercourse being deferred until fifteen or sixteen days after menstruation for the purpose of avoiding conception. If this delay were a cause, probably the number of cases would be much greater. Pinard has asked if travelling early in pregnancy, with consequent jolting in railroad cars or in carriages, may not cause placenta prævia. The recurrence of placenta prævia in the same subject has been observed. The cases recorded by Ingleby are explained by the abnormal point of entrance of the tubes into the uterus. Fitzpatrick⁴³ reports the case of a woman thirty-six years old who had nine pregnancies, the first four normal and ending in the birth of living children at term; in five successive pregnancies she had placenta prævia.

Symptoms and Diagnosis.—The most characteristic symptom of placenta prævia is hemorrhage occurring in the latter part of pregnancy or at the beginning of labor without obvious cause. The hemorrhage frequently begins when the patient is sitting quietly or even when lying asleep in bed. Lomer found in only thirty of 136 cases that the first hemorrhage was caused by some bodily exertion, such as lifting, straining, or coughing. Müller mentions coition as a cause. Winckel states that in lateral placenta prævia the first hemorrhage generally occurs after the thirty-second week, and in the central variety between the twenty-eighth and the thirty-sixth week. In rare cases not only of lateral but also of central implantation of the placenta there is no bleeding until a few days before labor, and in still rarer cases not until labor begins. Since Rigby's admirable essay⁴⁴ the hemorrhage occurring in placenta prævia has been called "unavoidable," while that which may happen when the placenta occupies its normal site is known as "accidental." In 1873, Matthews Duncan⁴⁵ took the position that the hemorrhages occurring during pregnancy on account of placenta prævia were not unavoidable, but accidental, their occurrence being promoted by the unusual conditions present, and especially by increased blood-pressure resulting from the lower position occupied by the placenta. Yet those who have read the essay of Rigby will remember that he referred only to the hemorrhages of labor, in case of placenta prævia, as being unavoidable.

While not many years distant some authorities regarded the hemorrhage as

* One of the most remarkable cases of placenta prævia is that given by W. J. Harris (*Lancet*, 1863). A woman was twice pregnant with twins, and in each pregnancy had placenta prævia.

placental, it is now usually conceded that it is uterine, and should the child die its death would be not from loss of blood, but from asphyxia. From the fetal circulation may come a small quantity of blood in case the chorionic villi are torn. Why the bleeding occurs in the latter part of pregnancy is a question that has had different answers. Jacquemier held, on the one hand—and his view, with qualifications, was accepted by Depaul—that the development of the lower part of the uterus was more rapid than that of the placenta, hence detachment of the latter; on the other hand, Legroux asserted that the placenta grew more rapidly than the uterus, that is, grew away from the uterus. Barnes has been especially prominent in upholding the latter view. Spiegelberg, first referring to placenta prævia predisposing to abortion, said: "Owing to the loose vascular connections of the placenta and to the higher blood-pressure in the placenta when inserted low, any shock is liable to cause rupture of its vessels and detachment; perhaps, also, shocks affect the lower portion of the uterus oftener than the upper during the first months of pregnancy (coitus, especially straining at stool). For the same reasons premature labor, too, is relatively common; indeed, I am convinced that even the hemorrhages which occur during the latter months of pregnancy depend upon commencing labor—that it is not the hemorrhages which induce premature labor, as is generally supposed, but that the converse relation is the true one."

The hemorrhage is not only abrupt and apparently causeless in occurrence—though this first hemorrhage may be fatal—but usually it ceases after lasting a few hours, or even in less time, and often spontaneously. The hemorrhage returns at irregular intervals, and is greater, occurs earlier, and is more frequent in those cases in which the placenta completely covers the os. >

Auvard⁴⁶ mentions as symptoms unfavorable presentation of the fetus—presentations other than those of the head* are found in from 20 to nearly 50 per cent. of cases, according to different authorities—the occurrence of premature labor, and premature rupture of the membranes. Winckel remarks that in the relation of the funis in placenta prævia there is also offered a certain predisposition to bleeding. He states that Scanzoni, Hugenberger, and the author found marginal and velamentous insertion of the cord frequent.

Hemorrhage occurring in the last two or three months of pregnancy without obvious cause, and especially if the patient has not albuminuria, would at once suggest the strong probability that it resulted from placenta prævia. Spencer⁴⁷ claims that it is possible by abdominal palpation to determine the site of the placenta when it is situated in the upper part of the uterus, and also by this means, on finding it absent from its usual site, it may be discovered in the lower portion of the uterus.

In examining the patient she lies upon her back, the bladder being previously emptied. The examination should be gentle and be made in the absence of pains, and should be prolonged over several minutes or be repeated

* Of course the frequency of abnormal presentations is in part to be attributed to the fact that in many cases labor is premature.

if necessary. Spencer gives the following additional directions: In an ordinary vertex presentation (placenta in the upper segment) the occiput, forehead (at a higher level), and side of the head may under favorable circumstances be felt distinctly in the lower segment of the uterus by means of abdominal palpation. In a case of placenta prævia in which the head presents the head is not felt where the placenta is situated; it is distinctly felt where the placenta is absent. In cases where the placenta is in front the organ is felt as an elastic mass, of the consistence of a wetted bath-sponge, that keeps the examining finger off the head. The edge of the placenta may be felt, and has the shape of a segment of a circle. Within the circle all is obscure to the touch; outside the circle the head or other part of the child is plainly felt. Impulses to the head are not clearly felt through the placenta; impulses to the head through the placenta are distinctly felt at the spot from which the placenta is absent. The same applies to combined vaginal and abdominal examination.

Vaginal examination shows great softening of the cervix, and the bluish discoloration is well marked, extending to the external genitals. The pulsation of vessels in the lower part of the uterus and vagina is distinct. The presenting part of the child cannot be recognized distinctly through the uterine wall and the overlying placenta. Probability becomes certainty* only when the finger can enter the os or penetrate the cervical canal, and the sponge-like structure of the placenta can be felt. We distinguish *complete* from *lateral* placenta prævia by the finger touching in the former placental tissue at all parts surrounding the internal os, while in the latter the membranes can be felt, and possibly only placenta reached, by passing the introduced finger toward one or the other side. It should be remembered that complete is much less frequent than lateral placenta prævia, and that in the latter the bleeding may not occur until labor begins.

Prognosis.—The prognosis is graver the earlier hemorrhage occurs and the more completely the placenta covers the os. Not only is there danger from bleeding before birth, but also afterward, for the relaxed lower segment does not completely close the vessels opened by detachment of the placenta. There is danger, also, especially in the so-called *accouchement forcé*, of fatal tearing of the cervix and of the lower uterine segment. Finally, the examinations and manipulations and the means used for the arrest of bleeding may lead to infection, so that, according to Kaltenbach, almost as many women die from sepsis and pyemia as from bleeding.

Maygrier⁴⁸ narrates four cases of fatal syncope in patients with placenta prævia, showing that severe hemorrhage from this anomaly can cause such grave anemia that death may come suddenly after the arrest of all bleeding. Müller gives the maternal mortality as 23 per cent. and the fetal as 64 per cent. King's⁴⁹ statistics show a maternal mortality of 22.5 per cent. and a fetal mortality of 57.2 per cent. Winckel believes the mortality from placenta prævia should not exceed 5 to 10 per cent. Such a low mortality as 5 per cent.

* Nauche claimed that by his metroscope pulsation in placental vessels could be recognized; but the claim was not verified, and the metroscope is now almost unknown.

may be secured in hospital but hardly in private practice. According to Lomer, 60 per cent. of the children die during labor; Barnes states that by his method he has had 33 per cent. of living children born; and Winkel says that the mortality of children is seldom less than 50 per cent., and in some statistics is as high as from 70 to 75 per cent. If spontaneous labor occurs, the mortality of children, according to Müller's statistics, is only 50 per cent. The chances of the child surviving in placenta prævia appear so small that some writers seem to take the ground that its life is not to be considered in determining the treatment. But this is wrong, and we fully endorse the words of Dr. Barnes:⁵⁰ "However, in admitting frankly that it is our first duty to save the mother, I insist upon the correlative law which does not permit us to sacrifice the child to this end without conclusive proof that it is only at this price the mother can be saved."

Treatment.—There is no single method of treatment in placenta prævia applicable in all cases and at all times; therefore the obstetrician will act most wisely who chooses means corresponding with the special features of the case in hand and with the emergencies that arise.

If the bleeding occurs in pregnancy, is not great, and uterine contractions are absent, rest in bed only may be advisable. Should the hemorrhage be severe, Winkel directs vaginal injections of hot water or of vinegar and hot water, and also the colpeurynter. Martin advises that there be provided aseptic balls of cotton-wool, with which the midwife or nurse should tampon the vagina after the use of an antiseptic injection, so that the hemorrhage may be arrested at once while awaiting the arrival of the physician. The induction of premature labor in placenta prævia was advocated in England several years ago, chiefly by Greenhalgh, and in America mainly by Thomas. For some years past Murphy of Sunderland has followed this practice, and his results, so far as saving mothers is concerned, have been remarkably good. His method of treatment will be referred to again. We believe that in many cases Spiegelberg is correct in saying that the hemorrhage in the latter months is caused by commencing labor. The obstetrician will simply then accept Nature's plan and facilitate her action.

Should there be hemorrhage in labor, the os dilatable, and lateral placenta prævia with presentation of the head, let the membranes be ruptured, for, as Martin states, we may expect the inferior pole of the fetus to occupy entirely the lower portion of the uterus, and the presenting part to press upon the bleeding placental site and to excite uterine contractions. In most cases of this variety of prævia placenta no other interference will be required; if, however, delay demands active interference, the forceps may be used. If the pelvis presents, the same plan of treatment is to be pursued, except that it is advisable to bring down a foot. In transverse presentation, of course, podalic version is indicated. But now suppose the physician is called to a case of placenta prævia in which the bleeding is severe, whether in pregnancy or in labor, and the os barely admits the finger and is rigid, or the cervical canal is not readily penetrable: most obstetric authorities agree in advising a tampon.

Winckel uses for this purpose iodoform cotton, and others advise iodoform gauze (Fig. 389); creolin gauze would be just as useful and has no unpleasant odor. Auvar^d* recommends cotton or charpie, 1500 grams being needed: this material is made into balls the size of a walnut, which are placed in a 2 per cent. solution of carbolic acid, or in a 4 per cent. solution of boric acid, or in a 1:1000 solution of corrosive sublimate, until thoroughly saturated. Before being used the fluid absorbed by these balls is squeezed out, and to facilitate their introduction and to secure thorough packing an antiseptic cerate is used. Fifty or sixty of the balls will be needed.

A Sims speculum greatly facilitates the introduction of a tampon. Winckel

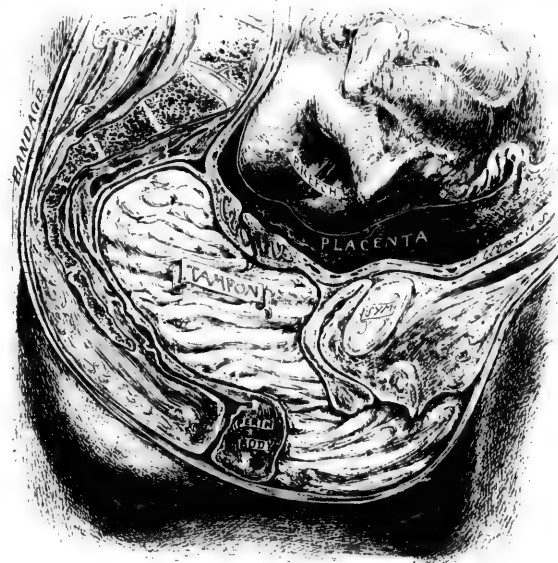


FIG. 389.—Placenta prævia: vagina tamponed with gauze.

states that a tampon may be applied so thoroughly that not a drop of blood can escape from the vulva. He leaves the tampon in place in central and lateral placenta prævia until the os is completely dilated, so that either the presenting part of the child can enter the os, thus itself making a tampon, or, by the introduction of the hand, the hips are brought down, thus accomplishing the same end. Barnes[†] would not leave a tampon in the vagina longer

* Pajot has said that a hatful of the material will be required.

† The following passage is taken, not from his paper at the Brussels Congress, but from his *Obstetric Medicine and Surgery*: "Vaginal plugs are treacherous aids, requiring the most vigorous watching. The plug, introduced with so much pain to the patient, soon becomes compressed, blood runs past it or accumulates above or around it, and the tide of life ebbs away unsuspected. Never leave the patient trusting to vaginal plugs. Feel her pulse frequently, watch her face closely, examine to see if any blood or tinged serum is oozing externally. Remove the plug in an hour at furthest, and feel if the os is dilating."

than an hour, but Bailly lets it remain for twenty-four hours, and Tarnier for twelve hours: the last practice is probably the best. Some—Pajot, for instance—let the tampon be expelled with the child.

The practice which has in recent years been received with most favor by the profession is, when the os can be entered by two fingers, the performance of bimanual version according to the method of Braxton Hicks, and bringing down a foot, so that tamponing is effected first by the leg, then by the thigh, and finally by the hips, of the child (Fig. 390). The labor is not hastened unless there is some special demand for its prompt ending, but gradual dilatation of the os is made. In case it be impossible to reach the membranes in complete placenta prævia, the placenta is perforated.

It appears that Martin, at a meeting of the Naturforscher at Hamburg (1876), and then in his *Guide to Obstetric Operations* (1877),⁶¹ made a definite proposal for the successful treatment of the majority of cases of placenta prævia, which treatment has later been established by Behm, Hofmeier, Schülein, and others. The chief point in this treatment is bringing down the hips, so that by their pressure bleeding from the loosened placenta may be stopped and at the same time uterine action may be developed.

If hemorrhage continues after the birth of the child, manual removal of the placenta is performed. If hemorrhage still continues, the injection of hot water, compression of the uterus, the administration of ergot, compression of the aorta, autotransfusion, injection into the rectum at frequent intervals of normal salt-solution, such as will be mentioned in the treatment of post-partum hemorrhage, and also the hypodermatic injection of the salt-solution, are among the important means to be employed. A bleeding tear in the cervix may be stitched. Broths and milk may be given as freely as they can be taken, and there may be required alcohol stimulants as well as the hypodermatic use of ether. Winckel commends the method of Breisky and of Klotz, of compressing the bleeding lower part of the uterus with one hand in the vagina and the other upon the abdomen, the compression being continued for half or three-quarters of an hour.

Dr. Barnes, in the paper already referred to, gives the following résumé of his method of treating placenta prævia:

- "1. Rupture the membranes; this disposes the uterus to contract.
- "2. Apply a firm bandage over the abdomen.
- "3. A tampon may be introduced to gain time, but it is not necessary to do it. Watch, observe with vigilance.
- "4. Detach all the placenta adhering within the inferior zone, and always watch. If there is no hemorrhage, wait a little. The uterus may perhaps do what is necessary. If this fails, dilate the cervix with the hydrostatic dilator. Wait and watch. If the natural forces fail, employ the forceps which gives the best chance to the child, or as a last resort perform version.
- "5. Avoid as far as possible everything which disposes to septicæmia. There are four factors which dispose to it: (a) The bruising and other lesions of the uterus; (b) the retention in the uterus of fragments of placenta or membranes

or of clots; (e) deficient contraction of the uterus; (d) activity of absorption, increased by loss of blood. All these causes are reduced to a minimum in following the preceding therapeutic principles. But there are still other



FIG. 390.—One leg has been drawn down, so that the os is tamponed and the placenta directly compressed by the hips of the child (Miller).

special precautions. After the placenta is expelled examine it carefully to see if it is entire. If the uterus does not contract well and if blood flows, inject hot water, temperature of 45° C., adding a little iodine or carbolic acid, or else, if the hemorrhage persists, the perchlorid of iron. It would be more

useful to repeat the uterine injections daily for a week. The activity of absorption indicates the use of a generous diet."

In connection with the method of Dr. Barnes, as above given, reference may be made to the plan pursued by another celebrated British obstetrician (Radford) in 1826: "A multipara in the seventh month of pregnancy had severe hemorrhage, for which a tampon was used; a month after this there was slight flooding, which yielded to rest, etc.; labor came on two weeks subsequently, and there was considerable hemorrhage. Upon examination the os was the size of a crown. As the pains were now frequent and strong and the discharge continued, after placing a regulating bandage—one end being fastened to the bed and the other held by the nurse and tightened as required—I passed my hand, and first detached a considerable portion of the placenta, and then ruptured the membranes. The bandage was drawn so as equally and firmly to support and compress the uterus as its size lessened by contraction and the escape of the waters." The result was favorable for both mother and child. Radford gave the reason for detaching the placenta thus: "I detached the placenta as freely as I thought necessary for the passage of the child, as it is better systematically to do this rather than run the risk of the tearing of the structure of this organ by the force it must sustain at each pain, when the os uteri has to be dilated by the head of the child after the membranes have been ruptured."

The point of interest in comparing these methods is that each obstetrician detached partially the placenta, though for a different reason.

Murphy, who has for years advocated and practised the induction of labor in placenta prævia, recently made the following statement:⁵² "In every case where placenta prævia is evident after the seventh month, or even before then, I bring on premature labor and remain with the patient until she is delivered, treating her on the lines laid down by Barnes." Murphy has now had 61 cases with only two deaths, and one of the two was moribund when first seen. Instead of the fiddle-bag dilators of Barnes some have used, for the induction of labor and at the same time to prevent hemorrhage, the *ballon* of Champetier de Ribes. Harris⁵³ recently recorded very successful results from dilating the os uteri with his fingers in placenta prævia. Parks Ritchie⁵⁴ narrates two cases of placenta prævia in which the mothers and children were saved by *accouchement forcé*.*

Accidental Hemorrhage.—The hemorrhage resulting from premature separation of the placenta occupying its normal site is called "accidental" (Fig. 391). This detachment may occur in pregnancy or in labor, but is much more frequent in the former; it may be complete or partial; the latter happens much oftener than the former. Premature detachment of the placenta is

* When the placenta was in advance of the child, or *filius ante patrem*, as Paré said it was called, *accouchement forcé* was held by the old accoucheurs as the essential method of delivery. Guillemeau (1649), according to Dunal, was the true inventor, or rather promoter, of this obstetric operation; but in recent years many of the cases reported as *accouchement forcé* are instances simply of rapid delivery, no violence being employed, and the term has thus been changed in its signification.

not a common event, for Goodell in 1870 collected only 105 cases of the accident.

Etiology.—Among the causes of accidental hemorrhage some of the acute infectious diseases, such as variola and scarlatina, have been asserted; but more obvious and more generally accepted are traumatisms, as from falls, blows, concussion, jolting, etc; so, too, direct pressure upon the abdomen, violent sneezing, coughing, straining, or vomiting. But in how many hundreds of cases many of these may occur without the placenta being separated from the uterine wall! Brevity of the cord, great distention of the uterus, as from plural pregnancy or excess of amniotic liquor, and simply the normal contractions of the uterus in pregnancy, have been included among the causes. Kaltenbach states that if the placenta is detached by the contractions, it must be

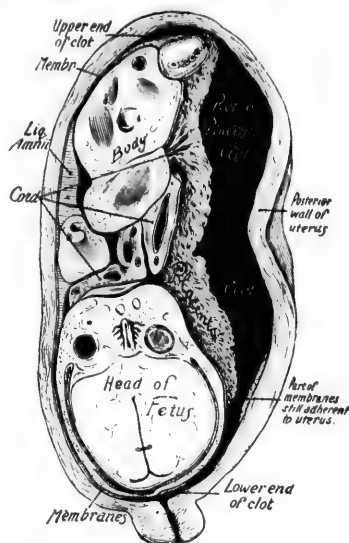


FIG. 391.—Accidental hemorrhage. Blood collected between placenta and part of membranes and the uterine wall (Pinard and Varnier).

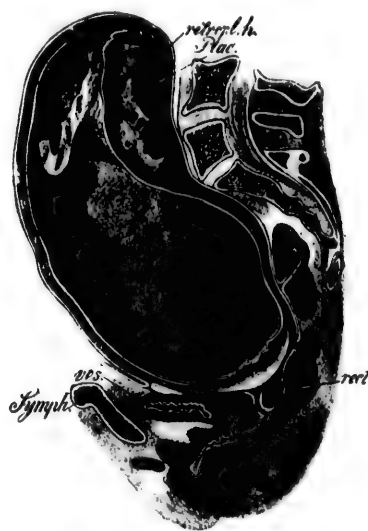


FIG. 392.—Premature detachment of the placenta occupying its normal site. Frozen section of an undelivered woman dead of eclampsia (after Dr. Winter). A blood mass under the placenta.

assumed that changes in the inner portion of the serotina have made the tissue friable and readily torn. The importance of nephritis as a cause for premature separation of the placenta has been established by Winter; but, as Veit has said,⁵⁵ we cannot explain the origin of the bleeding in renal maladies without the medium of endometritis; he maintains that the chief cause of premature detachment is disease of the decidue. That the placenta in these cases is diseased has been proved by several observers; infarcts have been found, also inflammation, and, in the case reported by Coe,⁵⁶ fatty degeneration.

Of 81 cases of accidental hemorrhage recorded by Johnston and Sinclair (*Practical Midwifery*), no cause could be found for its occurrence in forty-six. Graefe⁵⁷ has recently published a case of premature placental detachment in

which shortness of the cord was the cause of the accident ; the length was only 31 centimeters. The patient was a primigravida, and the first bleeding occurred about the time of the descent of the head into the pelvic cavity—that is, about four or five weeks before the normal end of pregnancy, but in this case ten days before labor. It was believed that partial detachment resulted from the strain upon the cord in the descent, the primary separation being in the lobe to which the cord was attached ; after birth the navel was immediately in front of the vulva. Underhill²⁸ has published a case in which severe pressure upon the abdomen was the immediate cause of the detachment : A large, powerful woman, quite heavy, in the ninth month of pregnancy, was engaged hanging clothes out of a window to dry, the greater part of her weight being supported by the window-sill, upon which her abdomen pressed. Violent uterine hemorrhage at once occurred, and the loss of blood was so great that she fainted. The writer had a case in which partial separation of the placenta was caused by a fall, the woman being at the end of the seventh month ; nearly a quart of blood was almost immediately discharged, and then the flow ceased. This patient went to term, being then delivered of a living, well-developed child.

Symptoms.—The bleeding is internal (that is, latent) or external. The illustration (Fig. 392), from Winter, shows a partially detached placenta with a mass of blood effused between the placenta and the uterine wall and also penetrating between the membranes and the uterus. In some instances the central portion of the placenta is first detached, and then the adjacent part, until the entire organ is separated except at the margin, which remains firm ; there is thus formed a large cup-shaped cavity filled with blood. Dr. Coe gives the following as the signs of latent accidental hemorrhage : Irregularity and feebleness of uterine "pains," the fundus only contracting ; the uterus is excessively sensitive ; the sounds of the fetal heart are irregular and feeble ; after a time increase in the size of the uterus, and the patient complains of its excessive distention ; palpation of the fetus is difficult or impossible, and in some cases there is a notable prominence at that part of the uterus in which pain has been felt ; finally, there are the constitutional manifestations of great loss of blood.*

Graefe, in considering the differential diagnosis of this accident, refers to the possibility of confounding the condition with rupture of the uterus, or with hemorrhage into the sac of the ovum or into the abdominal cavity in ectopic pregnancy.

The cases in which there is no external bleeding are rare. Usually after a longer or shorter time blood escapes externally, and then the diagnosis cannot be doubtful.

The accompanying illustrations (Fig. 393, A, B) show the blood escaping externally in accidental hemorrhage.

* Fritsch in the diagnosis states that the bag of waters remains tense and resistant during the intervals of uterine contractions, and that it is impossible by touch to reach the placenta (*Klinik der Geburtshilflichen Operationen*).

Prognosis.—The prognosis in accidental hemorrhage is bad for the mother, or at least very grave, and still worse for the child. Goodell's statistics include 106 cases, and the maternal mortality was fifty-four, while of 107 children only six lived; nineteen mothers were saved out of 32 recorded by Brunton. Galabin in the statistics of Guy's Hospital found 31 cases of accidental hemorrhage, twenty-one of them being severe; five of the mothers and 66 per cent. of the children perished. Johnston and Sinclair in 81 cases had only four deaths of mothers; and in Graefe's 14 cases only two mothers died.

As Schultze has pointed out, the death of the child in premature detachment of the placenta is to be attributed not to loss of blood, but to the failure in the elimination of carbonic acid. The prognosis is more favorable in external than in internal bleeding, and more favorable, too, if the condition of the os uteri permits prompt delivery.

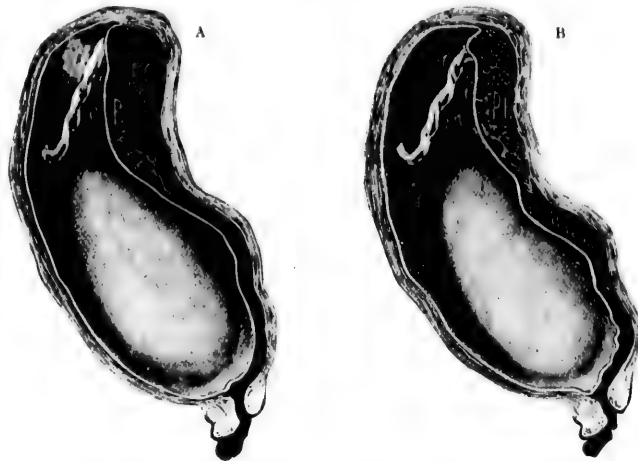


FIG. 303.—Showing separation of the placenta with external bleeding.

Treatment.—If external hemorrhage should occur during pregnancy, and if the quantity of blood discharged should not be great, the obstetrician will be content with enjoining the recumbent posture, cold drinks, the body lightly covered, and giving an opiate; in short, he will pursue a course similar to that required in threatened abortion. Even if there has been a copious discharge of blood, but bleeding has ceased, his chief efforts will be to relieve the patient from her prostration, no direct interference with the uterus being indicated. Possibly, as in the case under the care of the writer that has been previously mentioned, the pregnancy will not be interrupted and a living child will be born at term. Nevertheless, such a patient must be carefully watched, and the practitioner be prepared to act promptly should serious bleeding return; in brief, his state will be that of armed expectation.

Should there be continuous and considerable flow in pregnancy or in labor, and the os not be in a condition to admit immediate or speedy delivery, Spie-

gelberg regards the tampon as the best treatment. It should, however, be borne in mind that thereby an open may be converted into a concealed hemorrhage; and, though the pressure of a tampon in the vagina hastens dilatation of the os and evokes uterine contractions, these results are not constant. The internal bleeding may be very great, for, as William Hunter, in referring to the capacity of the pregnant uterus, said, "We are apt to consider the uterus, when containing the fetus and membranes, as being tight and distended, so as to preserve its shape when taken out of the body; sometimes it may be so, but in the state it generally is at the ninth month it will hold a pint, a quart, or now and then two quarts, or even more. It is in rather a loose state, not quite tight, and only about three parts full."

The tampon will be employed in only exceptional cases and but temporarily. Spiegelberg's injunction must be remembered: "The onset of internal hemorrhage must be looked for, and be prevented by carefully supervising the body of the uterus with the hand." It may be well to add that after the rupture of the membranes the tampon is positively forbidden.

If the labor can be ended promptly, rupture of the membranes is indicated, for discharge of the amniotic liquor is generally followed by stronger pains and arrest of the bleeding. This rupture is usually delayed until the os is half dilated, and then, should the hemorrhage continue, artificial delivery may be effected in a comparatively short time. Coe advises stimulants by the mouth, by the rectum, and hypodermatically, manual dilatation of the os followed by rupture of the membranes, and delivery by podalic version; if delay occurs from insufficient dilatation for the extraction of the head, craniotomy is done; ergot is also used. Goodell in his classic monograph⁵⁹ advised early rupture of the membranes, immediately followed by the application of a very tight binder and compresses to the abdomen, the free administration of ergot, and prompt delivery by the forceps or by version.

The Cesarean section, which has recently been recommended, is of questionable propriety, even in grave cases of accidental hemorrhage. Of course the usual means for securing contraction of the uterus when the labor is ended will be employed. So, too, those remedies that will compensate the loss of blood and hasten its restoration are indicated.

Hemorrhage after the Birth of the Child.—Severe bleeding after the child is born may have different sources. It may be caused by tears of the vagina, of the external sexual organs, or of the cervix; it may be a result of rupture or inversion of the uterus. But the present discussion includes only hemorrhage from the uterus occurring independently of lesions or displacement of that organ.

Great loss of blood may occur before or after the delivery of the placenta, but in the former case the placenta must be partially or completely detached, for while it is completely adherent to the uterine wall it is plain there can be no hemorrhage. Grave hemorrhage during or after the third stage of labor is rare, and many a careful and intelligent obstetrician will pass his professional life without witnessing a case, at least in his own practice. Herman⁶⁰ says

that the statistics of Guy's Hospital furnish but one case of dangerous post-partum hemorrhage in 2040 labors; of St. Thomas's Hospital, one in 2172; in Prussia, according to Hegar, one in 3131. Herman further states, and the profession will agree in the statement, that when so large a number of cases have recently been reported in which the iodoform-gauze tampon of the uterus was claimed to have arrested bleeding, the presumption is that many of these were cases in which the hemorrhage was slight. It might be added that in so large a number of cases some were proofs of careless obstetrics, for, as Spiegelberg has said, "I certainly do not exaggerate when I say that severe post-partum hemorrhage is almost without exception the fault of the attendant."

Etiology.—Atony of the uterus is the most frequent cause of hemorrhage after the child's being delivered; this hemorrhage, indeed, is frequently called "atonic bleeding." The causes of this failure of the uterine muscle to contract properly, closing the mouths of bleeding vessels, are many. The condition has been observed after a brief as well as after a long labor; it may follow a case of great distention of the uterus, as from plural pregnancy or from annial dropsy; prolonged and profound anesthesia predisposes to it. The bleeding may be in consequence of albuminuria or of hemophilia, in still other cases from deficient muscular development of the uterus. Veit⁶¹ refers, under atony of the uterus, to paralysis of that portion of the uterus to which the placenta has been attached—a condition which has been described by Engel, Rokitsky, Burehardt, Kiwisch, Chiari, and others. In this local uterine atony there is found upon abdominal examination of the uterus a depression, while internally, corresponding with the external depression, is a projecting mass.

Fritsch⁶² observed a case of local atony in which he found on section a complete varicose degeneration of a part of the uterus; the paralytic portion was composed almost entirely of wide veins. The same author mentions a very dangerous form of uterine atony the consequence of infection occurring early in labor, stating that it is not wonderful, when we observe that paralysis of the infected muscular coat of the bowels leads to meteorism, that the contractile activity of the uterus should fail from a similar cause.

Penrose,⁶³ in his paper upon the treatment of post-partum hemorrhage, remarks: "A cause sometimes of dreadful post-partum hemorrhage is the partial morbid adhesion of the placenta to the uterus; here there is often the reverse of uterine inertia; the uterus may be in a condition of firm contraction, but the adherent placental mass, occupying no little space in the cavity of the organ, prevents and renders impossible that degree of shrinkage in size indispensable to the complete obliteration of the uterine blood-vessels, and hemorrhage is the inevitable result. To this class of causes might be added those cases where the hemorrhage is caused by the presence of fibroids in the wall of the uterus or of a polypus in the cavity."

Placenta previa may cause post-partum hemorrhage, for the lower segment of the uterus has not the contractile power which belongs to that portion of the uterus in which the placenta has its normal site, hence the closure of torn

blood-vessels is not so prompt and complete, if the placenta be attached, in the former as in the latter. In concluding this topic we believe the prevention of post-partum hemorrhage is in most cases secured by proper management of the third stage of labor.

Symptoms.—Frequency of the pulse is often a herald of bleeding. Whether before or after the expulsion of the placenta, the obstetrician finds the pulse rising instead of falling, and, though the patient's general condition may appear favorable and the uterus appear well contracted, he will redouble his watchfulness, seeking to avert the threatened peril or to be prepared promptly to meet its coming. Possibly the patient herself may give the first danger-signal by asking if she is not "wasting too much" or "flooding," though frequently this expression of fear may be groundless. Oftener the physician is advertised of the dangerous condition by the expression of the patient's face—so deep a pallor upon it; probably she complains of some disorder of sense, such as "ringing in her ears" or obscurity of vision, saying that "the room is getting dark." Her face is not only pale, but also expresses anxiety; the pulse is feeble and frequent; the respirations are shallow, difficult, it may be gasping; the skin is cold and bathed in sweat; in the hunger for air she wants to have the window open and to be fanned; she may in her great restlessness move this way or that and toss her arms about restlessly and purposely. Possibly convulsions occur, and woe to the patient whose attendant mistakes them for an eclamptic attack! Sometimes the loss of blood may be so great that syncope occurs. Fortunately, however, this is not in the majority of cases immediately fatal.

The hemorrhage is either open or concealed—that is, external or internal. The Princess Charlotte died five and a half hours after a labor that had lasted fifty hours, the child being stillborn. The hemorrhage was internal. The autopsy proved a healthy condition of the organs, but the uterus, filled with blood, reached above the umbilicus. Of course an external hemorrhage reveals itself, and an internal bleeding will be readily recognized by the hand of the obstetrician placed upon the patient's abdomen, for thereby he finds the uterus greatly enlarged, relaxed, and probably its boundaries not easily defined. It ought to be noted that a bladder distended with urine may simulate an enlarged uterus, and, even if it does not, causes great ascension of that organ. To mention the possibility of the error is to avert it.

Post-partum hemorrhage has been divided into primary and secondary. Unfortunately, authors differ as to the boundary-line between the two, some including under the latter a bleeding that begins a few hours after labor, while others advance the limit to twenty-four hours or even some days. In the present discussion all hemorrhages occurring within the first twenty-four hours will be regarded as primary, and these only will now be considered, secondary hemorrhage being subsequently discussed.

Prognosis.—The prognosis is graver the earlier the bleeding occurs, and, of course, graver, too, the greater the loss of blood. The character of the discharge is also of prognostic significance, for if the blood is thin, serum-like,

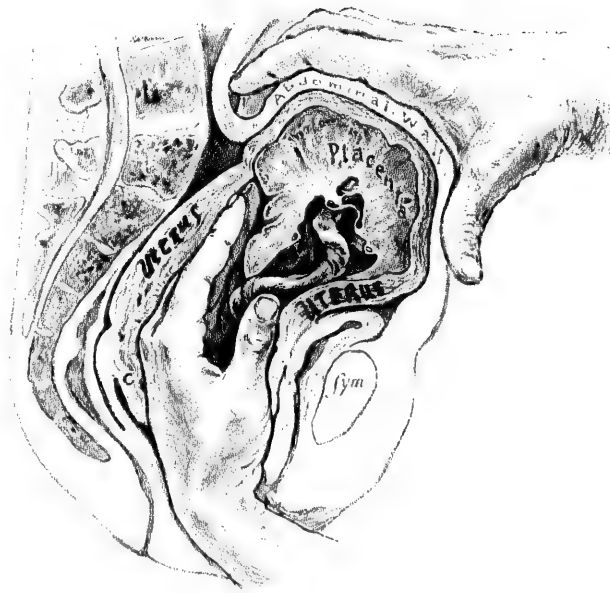
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Method of manipulation for artificial separation of the adherent placenta.



and without clots, the fluid itself is at fault and the danger of death is imminent. Severe pain in the back is regarded as testifying to uterine activity, and therefore as ground for encouragement. Hippocrates made hiccough and spasms ominous in hemorrhage, and Lachapelle counted dilatation of the pupils a grave prognostic sign.

Treatment.—It is of immediate importance to lessen the flow of blood and to excite uterine contraction. One step in the accomplishment of the first is to lower the patient's head, taking away pillow and bolster, and to raise the foot of the bed. Let the obstetrician by his words and acts prevent panic on the part of those present and inspire confidence and hope. Instant compression of the uterus is made, and the effort is exerted to promote its contraction by this pressure and by friction. The introduction of one hand into the uterus with the other upon the patient's abdomen may be necessary to remove the placenta or a part of it or coagula or membranes (Pl. 41). It is important before this manipulation that the genital canal be disinfected, which may be done by carbolic acid, creolin, or lysol, washing it out with hot water containing one of these antiseptics; furthermore, the hot water has this advantage, it stimulates the uterus to contract. Disinfection of the operator's hand and forearm is still more important, and this may be accomplished, Fehling states,⁶⁴ in five minutes by Fürbringer's method. This precaution is especially necessary if a partially free placenta is to be detached, for, as Stumpf has said, the manual detachment of the placenta is the most dangerous obstetric operation. The introduced hand by its contact with the uterine walls may evoke the action of the organ, and the removal of the uterine contents permits retraction. In the removal of the separated placenta it is usually better that both hand and placenta be expelled rather than withdrawn. Meantime ergot may be used hypodermatically with the hope of stimulating the uterus to contract. If the patient is very much exhausted by hemorrhage, sulphuric ether, as originally advised by Hecker—20 drops, for example—should be injected deeply in the thigh, three such injections being made.

Among the older means of evoking uterine contraction are striking the exposed abdomen with a wet towel, and the introduction of a lump of ice into the uterus. The obstetrician now generally prefers to the use of cold the injecting of hot water into the uterus. Penrose has for many years warmly advocated vinegar as an invaluable help in post-partum hemorrhage. He has given the following as his method of using it:⁶⁵ "I pour a few tablespoonfuls into a vessel, and dip into it some clean rag or a clean pocket-handkerchief. I then carry the saturated rag with my hand into the cavity of the uterus and squeeze it; the effect of the vinegar flowing over the sides of the uterus and through the vagina is magical. The relaxed and flabby uterine muscle instantly responds. The organ at once assumes what I will term its gizzard-like feel, shrinking down and compressing the operating hand, and in the vast majority of cases all hemorrhage ceases instantly; should one application of vinegar fail to secure sufficient contraction, the hand can be withdrawn, and a second or even a third application can be made, until the uterus shall con-

tract sufficiently to stop the flow of blood." Contamin in his monograph⁶⁶ states that "irritant substances placed in the uterine cavity act in the same manner as ice, and are more readily employed. In the time of Hippocrates a pomegranate from which the bark had been removed was introduced into the uterine cavity. In our days a lemon has been employed (Evrat, Moreau), or a sponge saturated with vinegar (Bigest, Desgrange). All these agents readily excite uterine contractions when they are immediately in contact with the walls of the womb."

Uterine injections are as old as the time of Hippocrates, but probably Pasta in 1750 first advised the introduction of a solution of "calceined vitriol" for the arrest of hemorrhage. Dr. Robert Barnes in 1857 strongly advocated injection of a solution of perchlorid of iron. The formula recommended by him is $1\frac{1}{2}$ ounces of the liquor ferri perchloridi (British Pharmacopœia) and $8\frac{1}{2}$ ounces of water. The following are his directions for the use of this solution:⁶⁷ (1) "Be sure that the uterus is empty of placenta, blood, and clots; (2) compress the body of the uterus during the injection; (3) have two basins at hand, one containing hot water, the other the ferric solution; pump water well through the syringe (a good Higginson's will do), so as to expel air, then pass the uterine tube into the uterus, and inject first hot water, so as to wash out the cavity and give a last opportunity for evoking diastolic contraction; then shift the receiving end of the syringe into the ferric solution, and slowly, gently inject about seven or eight ounces, carefully keeping up steady pressure on the uterus throughout and afterward." Spiegelberg⁶⁸ objects to the strength of the solution advised by Barnes, and suggests that half an ounce of the liquor ferri perchloridi be added to a pint of water, stating that "a high degree of concentration would undoubtedly corrode the internal surface of the uterus, and might thus lead to extensive and deep thrombosis of the uterine wall and to its sequelæ; it might also produce gangrenous endometritis and secondary infection, or cause the thrombi to be broken down and carried away by the veins." Some have advised, instead of injecting the uterus with an iron-salt solution, swabbing the bleeding surface with a sponge that has been dipped in the solution. In recent years, however, the employment of the Barnes method has had few advocates, not only because some fatal cases have followed it, but also because of the prompt hemostasis usually resulting from injections of hot water.

Dr. Atthill,⁶⁹ in December, 1877, in reporting to the Dublin Obstetrical Society some cases of post-partum hemorrhage in which he successfully used hot-water injections, stated that he was led to their employment because of a private letter from Dr. Whitwell of San Francisco. Dr. Whitwell's statement was to the following effect: When house-surgeon at the New York State Women's Hospital in 1874 he saw the uterus contract firmly and instantly upon being washed out with hot water after an operation by Dr. Marion Sims upon a sarcomatous growth of the fundus uteri. The result led him to try the same treatment in post-partum hemorrhage, and he met with perfect success. He afterward succeeded in having the treatment tried in the

Lying-in Hospital at Prague, and the method was so successful that it was adopted as a regular routine treatment. Windelband,⁷⁰ in January, 1875, stated that by the recommendation of an American physician living in New Foundland he had for a year employed hot-water injections, which were advised by this physician for the hemorrhage of abortion. Windelband used them not only in the hemorrhage in miscarriage, but also in that occurring in two cases of prævial placenta, in hemorrhage from uterine fibroids and other growths from the uterine walls, in bleeding after birth when the uterus was relaxed, and in profuse menstruation—in fact, in all cases of uterine hemorrhage. The water should have a temperature of 112° F., and an irrigator or a fountain syringe is preferable to the ordinary instrument. A little vaselin or cosmolin should be applied to those parts of the external sexual organs with which the fluid comes in contact as it escapes from the vagina, for without this precaution the patient will complain of severe burning. The nozzle of the syringe or irrigator should not be passed into the uterus until the stream has begun, thus guarding against the possible introduction of air; it is gradually carried as high in the uterine cavity as desired, the escaping stream making a way, as it were, and facilitating this movement.

Another method of arresting uterine hemorrhage is bimanual compression (Fig. 394). The patient lies upon her back with the lower limbs drawn up;

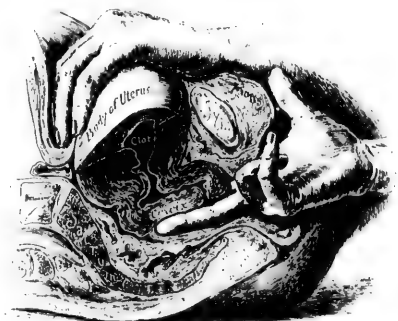


FIG. 394.—Bimanual compression of the uterus.

the obstetrician introduces one hand into the vagina, both hand and vagina having been carefully disinfected, and passes two or three fingers up to the posterior vaginal vault, so that he can exert a firm pressure upon the posterior part of the cervix; the other hand, placed upon the patient's abdomen, grasps the fundus and the posterior wall of the uterus, drawing them forward, the vaginal fingers at the same time pushing the cervix in the same direction; thus the uterus is anteфлекed and firmly held, so that hemorrhage for the time is impossible. The vaginal fingers may be applied to the cervix anteriorly, and the external hand to the fundus and the anterior surface of the uterus, and thus the organ may be retrofleked and arrest of bleeding be accomplished.

Fritsch⁷¹ speaks favorably of what he calls the "rational bandaging" of the

abdomen, saying: "Long prior to my injection of iron, and before Dührssen recommended the tampon, had I applied bandaging the abdomen in suitable cases, and with the best results. It is especially to be recommended in those cases in which, some time post-partum, the uterus is again distended with blood and the anemia has reached the border-line of imminent danger to life, as shown by great frequency or entire absence of the pulse. In such a case it requires considerable self-confidence to apply Dührssen's tampon, as during its application some blood is lost—at least that which saturates the tampon. In these cases I recommend and employ the following method: The uterus is pressed forward and anteverted; behind the uterus there is placed a large mass of cotton (one or two packages, amounting to 250 grams) or large pieces of muslin, or even a big book carefully and uniformly wrapped. Now a roller bandage is applied tightly, which not only compresses the abdomen, but acts upon the posterior wall of the uterus so that the organ is pushed toward the pelvic inlet. Additional turns of the bandage are made, passing above the fundus, and the uterus is fixed in its anterior position. The uterus is thus compressed in front and behind, lying against the pubic symphysis. By the abdominal compress pressure is also made upon the aorta. The blood is pressed, as it were, out of the abdomen and kept in the upper part of the body. This method, old as it is, still calls for occasional use, for it ensures prompt safety against bleeding, rapid recovery of consciousness, and an improved condition of the pulse. After such severe hemorrhage patients are not very sensitive. I have often let the bandage or compress remain twenty-four hours or longer without its removal being requested. At all events, we can in this way arrest the bleeding much more quickly than by the tampon, and at the same time we have the advantage of compression of the aorta. *I would especially advise this method of compression for those cases to which we are called in the final stages—the severest degree of hemorrhage. If seeing a case in the beginning, such great anemia may be averted by the prophylaxis of Dührssen's tampon.*"

Compression of the abdominal aorta has been successfully employed in post-partum bleeding. One of the recent arguments in its behalf is that it prevents cerebral anemia. Kaltenbach,⁷² while admitting the usefulness of this compression, regards it as doubtful whether the favorable action is to be attributed to a lessened blood-supply or to a mechanical irritation of the uterine plexus. The method usually pursued is as follows: Supposing the obstetrician to be upon the patient's right side, the abdominal wall is depressed with his left hand until the pulsation of the aorta is felt just above the uterus, and then slight pressure is made upon the vessel with three fingers, arresting the flow. An assistant is needed, for the fingers become too tired after twenty or thirty minutes to continue efficient pressure. Rudiger of Tubingen was probably the first to advise this treatment, and he exerted pressure on the vessel through the posterior wall of the uterus. This method was rejected, and Ulsamer's method, first advised in 1825, and previously given, is that generally employed.

The tampon is by no means a new way of treating uterine hemorrhage, but

its recent recommendation by Dührssen has revived its use. The vaginal tampon is now never used except possibly in tears of the cervix, and then but exceptionally, and tamponing the uterus will therefore only be presented. Leroux of Dijon and Chevreul of Angiers had numerous successes with the tampon; but, as Baudeloque has said, the tampon which they employed was a sponge saturated with vinegar, usually introduced into the uterus, and it was the action of the vinegar upon the walls of the uterus which was beneficial, and not the barrier which they supposed the sponge offered to the escape of blood. Other means of tamponing the uterus that have been recommended are an animal bladder or a rubber sac, either being introduced empty, and after the introduction filled with air or with a liquid. Zweifel recommended as a final resort, other suitable means having failed, tamponing the uterine cavity with cotton that had been dipped in a solution of chlorid of iron. He preferred this method to injecting the uterus with the solution, for a patient of his perished after such injection, while another recovered when this tampon was applied. In recent years the preference for gauze (usually iodoform gauze is selected, though some advise that which has been made antiseptic with creolin) has been decided. In tamponing the uterus three strips of gauze about the width of three fingers, each strip nearly 10 feet long, will be provided.* The strips have been dipped in a 20 per cent. solution of iodoform, and iodoform is sprinkled upon them just before they are used. The patient lies upon her back across the bed, and two tenaculum forceps are used, one to seize the anterior, the other the posterior, lip of the uterus, and by them the organ is drawn toward the vulva. An assistant holds these forceps. A long uterine dressing-forceps grasps one end of a strip of gauze, and is used to carry this up to the fundus of the uterus; at the same time the operator has his hand upon the patient's abdomen over the uterus. One fold after another is laid upon that first introduced, and thus successive layers are disposed like the folds of a closed fan until the strips are all introduced and the cavity is completely filled. The uterus contracts, it is claimed, because of the contact of a foreign body with its walls. The tampon does not cause suffering, and it is removed at the end of twenty-four hours, and the uterus is washed out with an antiseptic solution. No matter what tampon is used, it cannot succeed if fragments of placenta are left in the uterus; they therefore must be removed before its introduction.

Schauta, in his paper, *Die Behandlung der Blutungen post-partum*, after referring to his own successful employment of the gauze tampon, states that failures have been reported by Dührssen himself and by Fritsch and Ols-hausen, and advises, if the hemorrhage continues after the tampon has been introduced, that the strips be removed and fresh tamponing made after washing out the uterus, the gauze being packed more thoroughly. The tampon will be a failure, he says, in case the bleeding results from large arterial vessels that have undergone atheromatous degeneration, or even a single such

* Playfair has said that the puerperal uterus will hold two ball-dresses! This being true, one need not be astonished at the quantity of gauze required.

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vessel at the placental site. He adds that in such cases the removal of the uterus by supravaginal amputation may be considered in a well-conducted clinic, but in private practice would not as a rule be thought of. The proposition of Kocks he regards as worthy of consideration. This suggestion is to invert the uterus, and after the organ has been brought down it is to be encircled by a piece of rubber tubing or by a firm bandage, best of a strip of iodoform gauze, so placed that the placental site shall be below it. Necessarily the bleeding will be thus immediately arrested, and at the end of six hours the bandage is removed, and, the hemorrhage not reappearing, the uterus is restored, this restoration, according to the communication of Kocks, being accomplished without difficulty.

Kaltenbach states that the introduction of a gauze tampon is very difficult in case of a flaccid uterus, and often it is incompletely done, and thus the bleeding remains internal. He further states, after referring to the dangerous embolism which may result from injecting an iron solution, that the gauze tampon is especially applicable in cases of deficient coagulability of the blood.

Herman,⁷³ in criticising the gauze treatment, remarks that we must judge the effect of treatment of post-partum hemorrhage rather by the fewness of the failures than by the number of apparent successes. Fritsch has recorded a case in which death occurred from atonic hemorrhage notwithstanding the tampon; and other cases, in which the cause of death was not clear, have been published. One case of fatal air-embolism, occurring while the tampon was being introduced, has been reported. To the assertion that the treatment is neither certain nor safe he adds that it is unphysiological, for the uterus cannot be completely contracted while the gauze is in it. Certainly the cases are very rare in which this treatment will be required.

Quite exceptional, too, are those cases in which a departure from the rule, long established and almost universally held, that the uterus must be emptied of clots, is justifiable. "Turn out that clot!" has been the injunction of obstetric teachers for a century or more; yet it may be that in some very rare instances the direction should be, "Do not turn out that clot." In Contamin's paper the following case is narrated: "There are, nevertheless, cases in which clots seem to oppose a barrier to the flow of blood. In one of his patients Professor Bouchacourt three times emptied the uterus of clots. After each evacuation the hemorrhage recurred and clots were again formed in the uterine cavity. The patient was exhausted and syncope was imminent. As the size of the uterus was not very great and did not seem to increase, this fact indicating that the hemorrhage was suspended, the clots were left in the uterus. "The hemorrhage did not recur, and the following day the clots were spontaneously expelled. In this case the clots had the rôle of an obstacle to the flow of blood, and it might be asked, What would have happened if the obstetrician had determined at all hazards to empty the uterus? In exceptional cases only can this practice be followed. Nevertheless, we are justified in temporizing when the hemorrhage seems arrested, and especially if the firmness of the uterus indicates return of its contractions." To this case may be added

one recorded by Dr. James F. Hibberd,⁷⁴ in which a similar practice was successfully followed. There was this difference, however: Dr. Hibberd's patient fainted twice from the loss of blood.

The means for compensating the loss of blood are transfusion, autotransfusion, subcutaneous and intravenous infusion of a sterilized solution of chlorid of sodium—the so-called “normal salt-solution”—and rectal injections of this solution. Transfusion, in which the blood from another person is introduced into the venous circulation, is now scarcely ever employed. In autotransfusion the limbs are bandaged so that the great mass of blood which they contain is forced toward vital organs, especially the heart. In this operation flannel bandages are used, those of rubber being objected to because by their great compression thromboses, and later embolism, may be produced. For hypodermatic or intravenous use, and also for injections in the rectum, the physiological or normal salt-solution is prepared by adding 6 grams of chlorid of sodium to 1 liter of water free from germs. Winckel advises 1 drop of caustic solution of sodium to be added to the mixture. The hypodermatic application is made with Munchmeyer's apparatus, which consists of a funnel, a rubber tube, three needles, and a thermometer. Some select the upper portion of the thigh for the introduction of the fluid, and the quantity used in a case reported by Ziemssen was 1 liter: usually a much smaller amount will be sufficient. The method is fully presented in the treatment of *Eclampsia* (page 637), and therefore further details are not here given.

Before describing intravenous introduction of normal salt-solution it should be mentioned that much may be accomplished to prevent the injurious consequences of loss of blood by having the patient drink the fluid as freely as she can without causing irritability of the stomach, and also by injecting as much of it in the rectum from time to time as will be tolerated.

Intravenous injection of normal salt-solution, approximately one teaspoonful of salt to a pint of water that has been boiled and has a temperature of 100° F., may be made with a glass funnel, a rubber tube, and a cannula. Horrocks,⁷⁵ from whose paper the accompanying illustration (Fig. 395) is taken, describes the operation as follows: “Make an incision about one inch long and expose the median basilic or any other vein of not less calibre. In some cases it is found useful to cause filling of the vein by tying a pocket-handkerchief or bandage round the arm. With a needle pass a silk, gut, or other ligature under the vein, cutting it so as to leave two ligatures. Draw one to

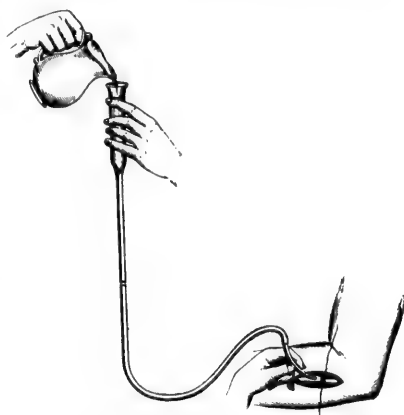


FIG. 395.—Intravenous injection.

the lower angle of the wound, and tie it round the vein by a double knot, cutting the ends short. With the dissecting-forceps pinch up the vein and make a small nick in it with scissors, taking care not to sever the vein completely. Introduce the cannula (silver or glass) into the vein, and tie it in by means of the upper ligature, leaving the ends long as in the Figure. The blood will flow down the cannula, and when it is full the rubber tubing, previously attached to the glass funnel and filled with the saline solution, is fixed on the end. The funnel is now raised, and as the water flows it is replaced by pouring in more of the saline solution from a jug (pitcher) held close to the rim to prevent air-bubbles being formed. As long as the funnel is kept above the level of the cannula, air-bubbles will always rise to the surface and escape. Another method of introduction, and one recommended in severe cases, is to fix the funnel and the cannula in the tubing, fill the apparatus with salt-solution till it runs out warm, and then to introduce the cannula into the vein, the funnel being held by an assistant slightly higher than the cannula, so as to keep up a gentle flow which washes away the oozing blood and ensures the absence of air. The speed at which the fluid is injected can be regulated by raising or lowering the funnel. In most cases a distance of about 3 feet is sufficient, and the flow is found to be about a pint every four minutes. When enough has been injected, remove the cannula from the vein. Cut the latter completely across, and tie the upper end with the long ends of the ligature. Sew up the wound with a continuous or interrupted fine silk or other suture, and fix a clean pad with a bandage."

Horrocks states that enough fluid should be injected to cause the pulse to be perceptible at the wrist, and that the worst cases require about six pints. Further, in the treatment of the prostrate condition Kaltenbach commends a rectal injection of red wine and the whites of two eggs with from 20 to 30 drops of tincture of opium. He also speaks favorably of an injection once or oftener, in the upper part of the thigh, of ether, tincture of musk, or camphorated oil (1 : 9).

Convalescence from the anemia resulting from severe bleeding will be best promoted by keeping the patient in a horizontal position, not even permitting her to sit up to nurse her child or to urinate. Milk, eggs, and animal broths should constitute the chief part of the diet, and alcoholic stimulants may be advisable in some cases. If the hemorrhage has been from the placental site, and especially if the flow is profuse and its bloody character is prolonged, ergot or fluid extract of hydrastis is indicated. The first getting out of bed will be delayed several days after the usual time in patients who have suffered from post-partum bleeding. Many patients will require the early administration of tonics—quinin and iron, for example, or the elixir of phosphate of iron, quinin, and strychnin, or the compound of "beef, wine, and iron."

Lacerations and Rupture of the Uterus.—These lesions are found almost exclusively in the lower segment of the uterus; most of them consist in tears of the uterine wall that run more or less transversely (Fig.

396). They are called "complete" ruptures of the uterus when the wound penetrates all three coats of that organ, and "incomplete" when either the serous or the mucous lining of the womb remains unimpaired. Lacerations in the upper portion of the uterus are exceedingly rare.

Causes.—Sharp ridges projecting from the pelvic bones have sometimes been known to sever the walls of the uterus. These projections are most likely to be found at the promontory and along the ilio-pectineal line. If there is any mechanical disproportion between the inlet of the pelvis and the fetal



FIG. 396.—Transverse rupture of lower segment of uterus (Spiegelberg): *a*, probe inserted under the peritoneum.



FIG. 397.—Impending rupture of uterus in a shoulder presentation (much modified from Schroeder): *oe*, external os; *ol*, internal os; *cr*, contraction-ring.

head, the latter in its descent will press the lower segment of the womb against these sharp ridges with so much force that they may grind their way into the uterine tissues. Any attempt to pull the head into the pelvis with forceps will under these conditions only help to increase the amount of injury to the uterus. Incomplete rupture of the uterus, with the inner portion of the wall entire, can have originated only in this manner.

By far the greatest number of ruptures of the uterus, however, are caused in an entirely different way. They are the direct result of the uterine contractions and of over-distention of the lower segment of the uterus. This mode of origin was first pointed out in 1875 by Bandl, and since then his statements have generally been accepted as correct. During labor the upper portion only of the uterus contracts, while the entire cervix and that portion of the body immediately above the inner os are subjected to a stretching process until they form one wide cylindrical canal. While this dilatation is going on we find that the wall of the lower segment gets thinner during each labor-pain, whereas the wall of the contracting portion of the uterus thickens and hardens. The border-line between the upper and the lower segment of the womb is marked by a ring-shaped projection of the contracting portion, the so-called "contraction-ring," which is found at a variable distance above the inner os. During the contractions the uterus has a tendency to move upward

toward the diaphragm and to pull the dilated lower segment upward and away from the presenting part, the latter usually descending at the same time, this partial evacuation of the uterus preventing an undue stretching of the lower segment. If, however, a malpresentation or some other mechanical impediment prevents the fetus from descending, the stretching of the lower segment continues. The uterus, as a rule, tries to overcome the obstacle by an increase in the intensity and duration of the contractions, thereby augmenting the chances for a rupture. When there is unequal dilatation—as, for instance, in shoulder presentation, in which the greatest stretching of the lower uterus takes place on that side to which the fetal head has escaped—the rupture becomes still more imminent (Fig. 397).

The administration of ergot during labor is at times directly responsible for uterine ruptures. The writer remembers a case of a multipara with central placenta prævia in which the attending physician had plugged the vagina very effectively, and at the same time had given the patient a teaspoonful of ergotol. The tampons together with the mass of the placenta made it impossible for the presenting head to enter the pelvis; it escaped to the left iliac fossa, and when the writer saw the patient two hours later he found a transverse laceration on the left side of the uterus a little above the inner os, through which the head had entered the abdominal cavity.

From what has been said above it is evident that these ruptures must always originate in the lower segment of the uterus; which fact, however, does not preclude the possibility of the tear extending upward into and above the contraction-ring.

Symptoms.—In a minor number of cases the rupture takes place without premonitory symptoms, but usually these symptoms are well marked. The parturient woman does not rest between the uterine contractions; she complains of constant and severe pain in the lower abdomen on account of the intense stretching to which the lower segment of the uterus and the uterine ligaments is being subjected. The rupture itself always takes place during a uterine contraction, and it is usually accompanied by an intense penetrating pain. At the same moment the parturient woman feels that the child has turned or has shifted its position. The labor-pains suddenly cease; there may be a free hemorrhage; the patient's skin gets cold and clammy; the pulse becomes very frequent and thread-like in volume. Some or all of these symptoms may be missing, with the exception of a change in the character of the pulse. The abrupt cessation of the uterine activity is also very constant.

On examination the presenting part will be found to have receded, or it may have entirely disappeared. Part or all of the child has escaped through the rent, and it can clearly be outlined through the abdominal wall. If the tear does not extend through the peritoneum, then this membrane is detached so as to form a large cavity which contains the escaped fetus and a greater or lesser quantity of blood.

Frequency of the Accident.—No reliable statistics as to the frequency of rupture of the uterus can be procured, as in maternity hospitals, to which com-

plicated cases are constantly forwarded, there will naturally be found a greater percentage of such accidents than if all labor cases from a large territory were collected for statistical purposes. In countries in which osteomalacia and rickets are common the frequency of pelvic contractions must necessarily increase the number of ruptures of the uterus. The frequency of this accident will vary also with the greater or lesser ability of the obstetrician. Bandl found one case of ruptured uterus among 1200 confinements, while Garrigues states the frequency as 1 in from 3000 to 5000; the latter statement seems to be approximately correct for the United States.

Prognosis.—Rupture of the uterus is one of the gravest complications of labor. Over 90 per cent. of the children are born dead, and of the mothers fully 60 per cent. succumb to the accident. Many women bleed to death before help can reach them; others die within the next few days from septic infection or from secondary hemorrhage.

Before antiseptic times the outlook was even more gloomy, but it has greatly improved within recent years, and we may hope that in the future a still greater percentage of mothers will be saved. According to statistics published by Schultz and quoted by Winckel in his text-book, the following percentage of cures was effected in the 193 cases collected from modern literature:

Complete ruptures without treatment, 20.2 per cent.

Complete ruptures treated with drainage only, 36 per cent.

Complete ruptures treated by laparotomy, 44.7 per cent.

Treatment.—Whenever during labor the over-distention of the lower segment of the uterus can be diagnosticated, an attempt must be made to deliver at once and to accomplish this without increasing the distention of the parts. The patient should be anesthetized, as the narcosis will lessen the intensity of the uterine contractions. The mode of delivery must be chosen according to the nature of the case. In shoulder presentations version carefully executed is the proper procedure, providing the child is living. Should the child be dead, then embryotomy would be preferable, as it does not increase the tension of the uterine walls, and consequently the danger of a rupture, while version, no matter how skilfully performed, will cause some additional distention. In head presentations a gentle attempt with the forceps should be made, always taking it for granted that the child is living. Failing with the forceps, the only choice lies between Cesarean section and craniotomy of the living child. Version in these cases is out of the question, because the stretching of the uterus in a transverse direction is very much greater when the operation is performed in head presentation than when it is resorted to in shoulder presentation, where the child lies already with its long axis more or less transversely in the uterus. Under favorable surroundings Cesarean section should always be the operation for treating this emergency, and craniotomy should be performed in those cases in which the child has ceased to live.

After the rupture has taken place a speedy delivery is also called for. If a part of the child is retained in the uterus, delivery through the natural passages should at once be attempted. Usually we are able to extract the child

by the feet. The placenta is removed next, and the parts are then cleaned and examined. Hemorrhage may not be very great, as the uterus generally contracts well as soon as it is completely emptied. The patient should be allowed to rest, and she may be stimulated with hypodermatic injections of ether, brandy, and like agents. If she rallies, the further treatment must be decided upon. The question will be: Shall the abdomen be opened, the rupture be closed by sutures, and the peritoneal cavity be cleansed of the blood and meconium that have entered it, or shall the treatment be confined simply to cleansing the vagina with disinfecting irrigations and introducing a glass tube or a roll of iodoform gauze into the rent in the uterine wall to provide drainage for the infected peritoneum? When the accident has happened amid surroundings that would not be objectionable to laparotomies for other causes, there is no good reason why the patient, provided she has rallied, should not be given the full benefit of the modern advance in abdominal surgery. Laparotomy performed under these conditions cannot expose the patient to any additional danger, but it can greatly improve her chances for recovery.

When the child has entirely escaped from the uterus or when it cannot be extracted through the *vias naturales* without greatly increasing the laceration, there is no choice in the mode of treatment. The abdomen must be opened and the child be taken away after ligating the umbilical cord; the placenta is best removed by compressing the uterus, when the after-birth usually glides down into the vagina, whence it can be extracted by the hand. The tear is now repaired by suturing, care being first taken to unite the muscular coat of the uterus, and then to close the peritoneum separately with the edges folded in, so as to ensure a good and speedy union.

Incomplete ruptures, with the peritoneum detached from the uterus, do not necessitate laparotomy. The newly-formed cavity is washed out through the rent and a drainage-tube or a roll of iodoform gauze is inserted to give escape to the secretions. The same treatment is pursued in complete ruptures, as already stated, whenever laparotomy is decided against. In the latter case no attempt should be made to wash out the abdominal cavity through such a tube: the tube should serve only for drainage.

Injuries to the Infravaginal Portion of the Uterus.—Physiologically there is a laceration of the vaginal portion of the cervix in all primiparæ and also in some multiparæ. This laceration, which is usually bilateral, runs in a transverse direction, so that in women who have borne children the external os is no longer a small round opening surrounded by a perfect ring of tissue, but is a more or less funnel-shaped aperture placed transversely between two well-marked lips.

It is only when these tears are excessive that they gain pathological importance. This is the case when the laceration extends upward to the vaginal vault and above it, or when it is accompanied by considerable hemorrhage. In some cases the anterior lip of the cervix is wedged in between the fetal head and the pubic arch, and it may be torn off more or less completely. By

annular lacerations of the cervix (Figs. 398-403) are meant those very rare cases in which the external os is unyielding and in which the whole lower section of the vaginal portion has by the descending head been forced off in the shape of a circular flap containing the external os in its centre (Fig. 404).

Causes.—The more extensive lacerations of the cervix are almost always caused by obstetrical operations at a time when the cervix uteri is not sufficiently dilated to allow an easy passage of the fetus. In some few instances pathological changes in the tissues of the cervix are to blame for these injuries.



FIG. 398.—Cervix of virgin (Heitzmann).



FIG. 399.—Another form of external os in the virgin (Heitzmann).



FIG. 400.—Cervix after miscarriage (Heitzmann).

At times the uterine contractions are so severe and frequent that they force the presenting part through the cervix before the latter has had time to dilate. Not unfrequently the administration of ergot during the first stage of labor, or rupture of the bag of waters before the os is fully dilated, has provoked these dangerous labor-pains. It is stated that prolonged labors are more



FIG. 401.—Cervix of multipara (Heitzmann).



FIG. 402.—Bilateral laceration to vaginal walls with eversion (Heitzmann).



FIG. 403.—Extensive laceration involving supra-vaginal cervix and vaginal wall (Heitzmann).

fertile causes of cervical injury than rapid labors, on account of the long-continued compression of the cervical tissues.

Symptoms.—It is only in a minority of cases that there are symptoms present of sufficient gravity to lead to immediate discovery of the excessive laceration of the cervix at the time of its occurrence. Intense pain is sometimes present, more particularly in those cases in which the rent extends upward through the vault of the vagina to the neighborhood of the peritoneum. The hemorrhage, usually trifling, is now and then so severe as directly to endanger the life of the patient. When a post-partum hemorrhage is noticed while the uterus is firmly contracted a close examination must be made of the

lower portion of the genital canal; if it is found that there is no lesion of the vulva or of the vagina that could cause the bleeding, it will be an easy matter to trace its origin to an injury of the cervix. If needs be the cervix may be pulled down into the vaginal orifice to allow of inspection. During the puerperal state an extensive laceration of the cervix increases the danger of puerperal septicemia and, at a later period, it may lead to chronic uterine disease.

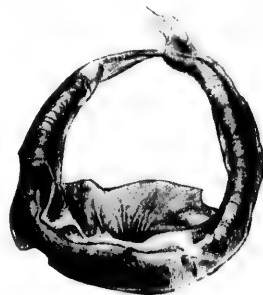


FIG. 404.—External os and a portion of the cervix higher up, which have been torn off during delivery (Winckel).

Treatment.—The prophylactic treatment necessitates deferring all obstetric operations until the cervix is fully dilated. This waiting is not always practicable, and we often have to choose the lesser to anticipate the greater evil, but we should never operate under these conditions without the

most urgent indications. The administration of ergot during labor at any time before the birth of the child is accompanied by so many dangers to both mother and offspring that no terms are too strong to denounce this nefarious practice.

Profuse hemorrhage from a tear in the cervix will sometimes be arrested by hot-water injections or by direct compression of the parts either by the

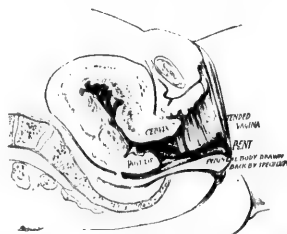


FIG. 405.—Laceration through the left side of the cervix into the broad ligament to the ischial spine and along the vagina through the perineal pyramid.

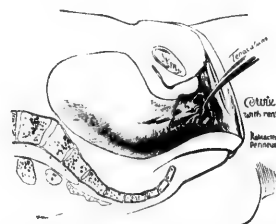


FIG. 406.—The two lower corners of the lateral laceration of the cervix seized by a double tenaculum and drawn down to make ready for suturing (Dickinson).

finger or by a tampon placed against the bleeding surface. In most cases, however, it is preferable to unite the torn tissues by sutures. The vagina is held open by vaginal specula or holders and the cervix is pulled down with a volsella or with a pair of Muzeaux forceps until it appears in the vulva, when the sutures can usually be applied without much difficulty (Figs. 405, 406).

Inversion of the Uterus.—By complete inversion of the uterus is meant that change of position and form in which the fundus is the lowest and the cervix the highest part of the organ, and the external surface is the internal;

the shortest definition of uterine inversion is, the uterus upside down and inside out.

Varieties.—We have here to consider only what is known as puerperal inversion, and of it there are two or three varieties, according to the degree of the displacement of the organ. The first degree, constituting one of the forms of incomplete inversion, consists in cupping or depression of the fundus of the uterus. Should the fundus descend so that it is at, or partially projects from, the os, the inversion is still incomplete; but if the fundus and the body of the uterus have passed through the os, the inversion is complete. If the inverted organ is external, the vagina also being inverted, the greatest displacement is present, and it is complete inversion with prolapse. Into the funnel-shaped cavity formed by the organ internally, and lined with peritoneum, the Fallopian tubes, the ovarian ligaments, round and broad, the ovaries in part, or a portion of intestine or of omentum, may enter (Figs. 407, 408).

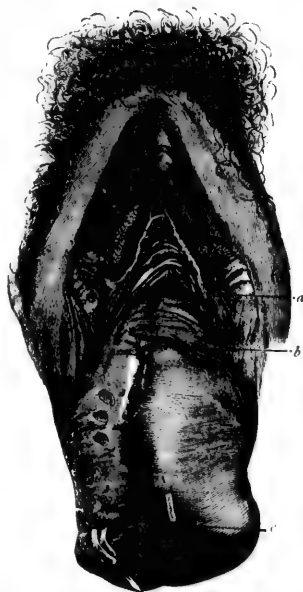


FIG. 407.—Inversion of uterus: drawing from an old specimen in alcohol. The atonic chief site of placental attachment (*c*) is shrunken by the alcohol, and thus its lessening is explained; *b*, contraction-ring; *a*, external os uteri (after J. Veit).



FIG. 408.—Inversion of the uterus. The lumen of the rectum is seen, and also the inversion funnel in which are the tubes and an ovary (after J. Veit).

Frequency.—We have no conclusive statistics as to the frequency of this accident. Winckel⁷⁶ in more than 20,000 labors has not seen a case of complete inversion, nor had Braun one in 250,000. Denham in 100,000 cases of labor in the Rotunda Hospital, Dublin, found one case of inversion. Kehrer⁷⁷ states that the accident is thought to occur once in 2000 labors. Probably uterine inversion is more frequent than published reports of cases would lead

one to believe. It may be that in some cases if the displacement was recognized the fact was concealed; in other instances the accident was not discovered.

Etiology.—Relaxation of the uterus necessarily precedes inversion. Matthews Duncan has stated:⁷⁸ "Four kinds of uterine inversion occur after delivery:

1. Spontaneous passive uterine inversion;
2. Artificial passive uterine inversion;
3. Spontaneous active uterine inversion;
4. Artificial active uterine inversion.

The only uterine condition essential to the production of all these kinds is paralysis or inertia or complete inaction."

Without entering into the various explanations of uterine inversion given by Duncan, this accident may originate in three ways:

1. There may be spontaneous inversion. Paralysis of the uterus at the placental site existing, simply the weight of the placenta may cause sinking of that portion of the uterus in the cavity. Such occurrence is more liable to happen if the placenta is attached at the fundus; then, the remaining portion of the uterus being active, the introcedent part becomes a foreign body, and by peristaltic action is forced farther down, just as happens in intussusception of the bowels. So, too, in complete paralysis of the uterus the organ may be inverted by the weight of the placenta. Each of these forms of spontaneous inversion is rare: some, indeed, regard them as doubtful.

2. The inversion may be caused by abdominal pressure or by the pressure of the hand upon the uterus. Kaltenbach states that he saw an inversion produced by the practitioner, in endeavoring to express the placenta, continuing to press after the uterine contraction had ceased.* Denuce⁷⁹ quotes a passage from Galen showing that this great physician knew uterine inversion could be caused by spontaneous abdominal pressure.

3. Inversion is most frequently produced by pulling upon the cord, and this may occur in spontaneous expulsion or in extraction of the child, there being absolute or relative shortening of the funis. Again, it may happen if the child is expelled when the mother is standing, the sudden strain of the child's weight in falling, acting upon the attached placenta through the cord, producing inversion.

Much oftener, however, the uterus is inverted by improper or untimely traction upon the cord in an effort to remove the placenta, this traction being made soon after the birth of the child. The uterus may then be in a relaxed condition, and especially at this time its lower segment and the os, having been recently stretched to the utmost in the passage of the child, can oppose only slight resistance to the descent of the inverted part. It has been asserted that if pulling upon the cord was liable to cause such result, the accident would be very much more frequent, because so many obstetric attendants,

* A similar case has been previously reported by Johnston (Johnston and Sinclair's *Practical Midwifery*).

especially midwives, resort to it for the removal of the placenta. But the answer to this is that such employment of traction is not usually made almost immediately after birth, and therefore the condition of the uterus, contractions having returned, cannot promote the accident. There are too many histories of inversion being caused by untimely or excessive pulling upon the cord for one to doubt that this is the most frequent cause of the accident.

While in the great majority of cases inversion occurs during the third stage of labor, it may exceptionally happen hours or days after delivery. Denuec, in describing tardy inversions, *inversions tardives*, assumes a semi-paralysis of the placental portion of the uterine wall, which becomes therefore depressed, and the depression furnishes a receptacle inviting intestinal pressure. He observes: "Such pressure, acting as in hernias, increases the extent and depth of the inverted portion and thus causes true secondary inversion." Again: "These late inversions may happen in different ways. Sometimes the intestinal pressure, acting in a continuous manner, gradually produces the inversion; sometimes, on the other hand, suddenly and under the influence of an abrupt and accidental effort or successive efforts the inversion results."

We have thus explained the fact that in rare instances competent obstetricians have met with cases of inversion when the labor was properly conducted, and at its end the uterus occupied its normal position, the displacement occurring hours or even days after. Of course in such cases no blame can be attached to the practitioner. That an inversion may begin at the cervix, as has been taught by some celebrated obstetricians, this part becoming everted and then drawing down the rest of the uterus, is in the highest degree improbable; especially is the apparent improbability great since we have learned in recent years more of the passive character in labor of the lower uterine segment.

Symptoms.—The most important symptoms of this accident are shock and hemorrhage. The hemorrhage is inevitable if the placenta be partially or completely detached. There may be vomiting in consequence of the stretching of the nerves in the lower part of the abdomen and of the pelvis, and syncope; there may be reflex paralysis of the heart; anemia of the brain from the sudden decrease in the intra-abdominal pressure may occur. Kehrer speaks of the collapse as being anemic-nervous. If there be complete inversion with prolapse, there is in front of the vulva a large ovoidal body as represented in the illustration (Fig. 409). In quite exceptional cases inversion may occur, as asserted by Reeve,⁸⁰ "without sufficient symptoms to attract attention or to indicate that anything has gone wrong." In support of this statement Reeve, unsurpassed in obstetric knowledge and learning, adduced only two cases, both in the practice of the same obstetrician; therefore the accident thus occurring must be exceedingly rare.

Diagnosis.—If the obstetrician is present at the time of the accident, and if the placenta is still attached, wholly or partially, to the inverted organ, a mistake is impossible. In other cases the history points to inversion, and the

symptoms presented assist the diagnosis, which finally must rest upon a direct examination. This examination must be made with the greatest care, for, though in the majority of cases a correct conclusion can be reached with absolute certainty, yet mistakes have been made even by men illustrious in the profession, though these errors have usually been in the diagnosis of chronic inversion.

One of the first things for the examiner to do is to pass a catheter in the bladder, for this organ distended with urine—as it probably will be if some hours have elapsed since the accident—may be mistaken for the uterus.

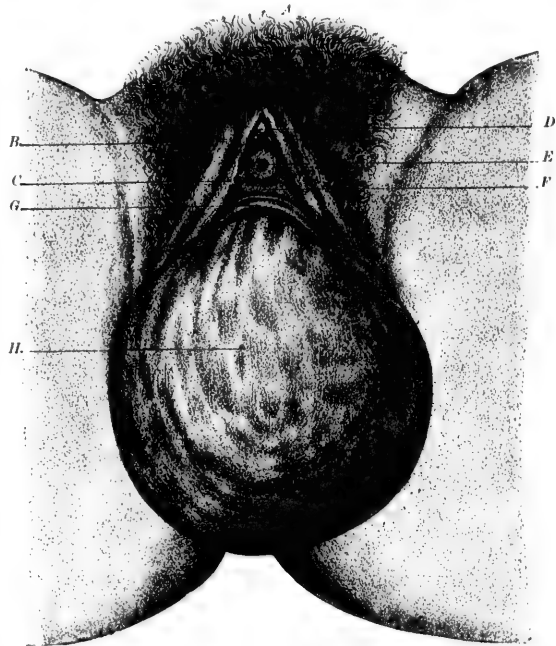


FIG. 409.—Complete inversion with prolapse (Boivin and Dugés): *A*, mons veneris; *B*, labia majora; *C*, labia minora; *D*, clitoris; *E*, urinary meatus; *F*, external anterior border of the vagina; *G*, external border of the os uteri; *H*, the internal surface of the uterus, now external.

Moreover, the bladder must be empty in order that abdominal palpation can be made. No matter, then, what oral information may be given that the patient has recently urinated freely, let the physician know for himself, and this knowledge can be best obtained by the catheter. If the uterus is extra-vaginal, its general appearance is fairly given in the illustration (Fig. 409). More frequently, especially if the examination is made some hours or a day or two after the inversion occurred, the uterus is intra-vaginal, and by no means the size represented in the illustration. If the vagina is of normal dimensions, the hand can be readily introduced, notwithstanding the presence of the uterus. Thereby the examiner feels a soft, probably sensitive,

possibly contracting, pear-shaped tumor, the larger end below. By means of one or two fingers introduced into the rectum and directed forward the funnel-shaped opening of the uterus is felt. If a sound should be passed into the bladder while two fingers are in the rectum, the ends of the latter may be brought in close approximation with the knob of the sound above the vaginal tumor. By abdominal examination the body of the uterus cannot be felt, but if the abdominal wall is not very thick and not sensitive—and the rule is that in great loss of blood sensibility to pain is much lessened—the depression formed by the entrance to the new uterine cavity can be recognized.

Denuce gives the following diagnostic marks of inversion and polypus :

1. The circular, not lateral, implantation of the pedicle ;
2. The openings of the tubes upon the inferior portion of the tumor ;
3. The special sensibility, sometimes accompanied by special contractility, that it offers to pressure and to acupuncture :
4. The half reduction which can always be made in inversions, never with polypi ;
5. The absence of the uterus from its ordinary place, ascertained by rectal and vesical examination.

Now, we have to say as to these diagnostic marks, first, that finding the openings of the oviducts is not always easy under the circumstances, and that we know that an inverted uterus may reveal no contractility, and that it may be insensitive, possibly in consequence of the utter prostration of the subject, to pressure and to acupuncture, so that the absence of these particular signs does not prove that the suspected tumor is other than an inverted uterus.

Prognosis.—According to Crosse,⁸¹ one-third of the women with puerperal inversion of the uterus die either immediately or within a month. In seventy-two of 109 fatal cases collected by him death occurred within seventy-two hours, usually within half an hour. Crampton⁸² in 1885 collected 120 cases ; there were eighty-seven recoveries, thirty-two deaths, and one remained unrelieved. Winckel, after quoting Crosse's statistics, states that in 54 recent cases only twelve died. But even this comparatively low mortality proves that inversion of the uterus is one of the gravest accidents of labor. Patients may die from shock or from bleeding ; the death may not be immediate, and then it may occur from incarceration of a loop of intestine in the inverted uterus, from peritonitis, from puerperal infection, or from gangrenous inflammation of the uterus. In very rare instances recovery has followed the separation by sloughing of this organ. Spontaneous restoration of the uterus has occasionally taken place. Schütz⁸³ states that ten such cases are known. Sometimes this has occurred after the failure of artificial means.

Treatment.—Of course the prophylaxis is of primary importance. Let the recumbent position be insisted upon in delivery. If brevity of the funis be recognized, promptly dividing the cord is indicated. In removing the placenta let no traction be made upon the cord, or at least no traction except during a pain. If compression of the uterus is made in efforts to express the placenta,

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The accident having occurred, restoration of the inverted organ is to be made: this restoration will be more readily effected the sooner it follows the accident. If the placenta is undetached, and especially if partially attached, it should be removed. The opinion of the majority of obstetric authorities is in favor of first removing the placenta before attempting reposition. Crampton remarks: "Firm and continued pressure upon any part of the inverted organ, the patient, if possible, under the influence of ether, will suffice in the great majority of cases to reposit a recently-inverted uterus. Thus in 92 instances of recent inversion reduction was effected in from five minutes to eight and a half hours." He gives the mortality as 20 per cent., whatever the treatment.

The restoration of the inverted uterus is best made with the hands. Of course the hands, as well as the vagina and the projecting uterus, must first be carefully disinfected. Then one hand is placed in the vagina, grasping, compressing, and pushing the organ upward, while the other hand is placed upon the abdomen, in part to make counter-pressure and in part to dilate the ring at the mouth of "the inversion funnel." In this effort the operator seeks to restore first that part of the uterus which came out last. According to Kaltensbach, the restoration is, as a rule, easily accomplished, even without narcosis.

The objection to beginning the reduction at the fundus, depressing it, and thus restoring first that which came out first, is that thereby a greater thickness of uterine walls must be passed through the constriction-ring. M'Clin-tock⁸⁴ has said, in criticism of this method: "By proceeding after this manner we should give the uterine walls a second inflection, and we should necessarily

require a greater dilatation of the constriction to admit of reposition. The accompanying diagram (Fig. 410) will help to bring out my meaning. Here *a* is the angle of inflection caused by the inversion; *b* indicates the position of the os uteri; and *c* shows how the second angle of inflection would be produced by depressing the fundus, which the dotted line represents. It would appear, therefore, that in the attempt to re-invert the uterus we should aim at replacing the part that has last come down, and so changing the angle of inflection according as each successive circle of the cervix and body is pushed up." The same objection holds if the indentation be made at one of the tubes instead of at the fundus.

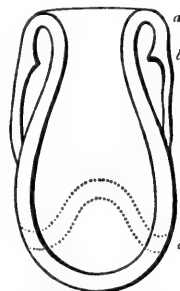


FIG. 410.—Inversion of uterus: improper method of restoration.

After the reduction uterine retraction is sought by irrigating the cavity with hot water and by the administration of ergot; packing the uterus with iodoform gauze, as some have recommended, is unnecessary. If reduction be impossible without too prolonged or violent manipulation, it is better to wait until the puerperal period has passed. A restoration immediately followed by the death of the patient can hardly be counted an obstetric triumph. Delay, too, is advisable if the patient is not seen until a few days after the

accident: immediate peril has passed, and new peril may arise from active efforts at reduction made during the lochial flow. After this flow has ceased reposition may be attempted by continued elastic pressure—as, for example, by a colpeurynter filled with warm water.

If returning the uterus is impossible—and the reduction of an inversion is literally *re-turning*—it is generally advised to control hemorrhage by ergot and by local application of astringents and refrigerants. Denuce commends lactation if the patient's strength permits, stating that the hemorrhages are almost completely suppressed while she nurses.

3. DYSTOCIA DUE TO DISEASES OF THE MOTHER.

Eclampsia.—Eclampsia (*εκλαμψις*, a shining forth, from *εκλαμπο*, to flash) is now commonly used as a synonym for puerperal convulsions. It may occur in pregnancy, in labor, or in childbed. It is characterized by a series of convulsive movements and loss of consciousness, and coma follows. Martin's definition is, "Convulsions of the entire body with loss of consciousness."⁸⁵

Desormeaux⁸⁶ stated that Hippocrates and the ancient physicians employed the word *εκλαμψις* metaphorically to express the exaltation of the vital properties, the scintillation of the fire of life, according to the expression of commentators, that occurs at the epoch of puberty. "Some modern writers have called eclampsia the epileptiform convulsions which are transiently developed, and as the effect of an appreciable cause, in certain individuals, and more especially the convulsions that occur in infants during dentition and in women in pregnancy or labor. It is this last variety, designated by Sauvages *eclampsia parturientium*, to which the term eclampsia is now usually restricted."

The disease presents a strong resemblance to epilepsy, with which it has sometimes been confounded. Eclampsia is not rare; its danger to the mother, and especially to her unborn child, is great, and even if the former should escape immediate death, she is liable to septic infection or to chronic nephritis, and sequelæ involving the psycho-motor or psycho-sensorial centres are not uncommon. Moreover, its essential etiology is not settled beyond all controversy, nor is there perfect professional agreement in all things concerning the medical and obstetrical treatment. For these reasons, therefore, the subject is of great importance, and it demands careful consideration.

Frequency.—The statements of authorities differ in regard to the proportion of those attacked. Auvard⁴⁶ gives 3 in 1000; Martin and Kaltenbach,⁸⁷ 1 in 500; Vinay,⁸⁸ 1 in 250 or 260: the last statement we believe is at least approximately correct. The reports of the Philadelphia Board of Health show that in the five years beginning with 1868 and ending with 1872 there were 47,191 children born, and in that period 132 women died from eclampsia. Assuming that the disease was mortal in 25 per cent. of cases, that is, three recovered for one that died—we believe that this is a fair estimate of the mortality—the entire number of cases of eclampsia occurring in the five years was 525, or 1 in 170 labors. From 1888 to 1892, inclusive, there were

141,235 births, and 99 cases of deaths from eclampsia. Approximately, then, there were 396 cases of the disease in that period, or 1 to 381 labors. It appears, therefore, that the disease was more than twice as frequent in the first period as it was in the second: the partial interpretation of this fact will appear in a moment.

Absolute accuracy is not claimed for these statistics, for some of the births were plural; hence the entire number of children born must be greater than the actual number of labors. Further, errors may arise as to the cause of death given by the physician, and thus the patient suffering from eclampsia may have perished from septic or from renal disease, and the death have been thus reported. It cannot justly be asserted that there has been such advance in the treatment of the disease that the mortality has been lessened more than one-half. A partial explanation of the difference is given by the fact that eclampsia is more frequent at certain times than at others. Kaltenbach directs attention not only to this fact, but also to these: the disease occurs more frequently in certain places, and likewise varies in its severity. In illustration of the variation in frequency of eclampsia at certain times, the statistics from which we have quoted show, estimating the actual number from the number that died, that in 1891 there were 136 cases, or 1 in 213 labors; but in 1890 and 1892 the proportion was only 1 in 496 labors—not half so many in the two years as in the intervening year.

Periods and Time when Eclampsia most Frequently Occurs.—We have not merely to consider the several periods in which the disease is manifested, but also the time in each of those periods. Kaltenbach's statement is that while the disease may appear toward the end of pregnancy, it is most frequent in labor, most seldom after it. Pajot has given the following: During labor, 100; before, 60; and after, 40. The recent studies of Goldberg,⁸⁹ including 1120 cases, show that in 21.07 per cent. the disease appeared in pregnancy; in labor, 56.34 per cent.; and after, in 22.59 per cent. Bailly,⁹⁰ in his admirable article upon *Eclampsia*, has taken the position that the order in frequency is pregnancy, labor, and the lying-in, and he has attributed, as we believe justly, the discrepancy so common among authorities in part to the fact that, as the disease so generally induces labor, cases that really begin in pregnancy have been included in those that belong to labor, sufficient care not having been taken to observe the actual time when the attacks commenced. Nevertheless, the statistics of Goldberg cannot be set aside, and we accept the results as at least approximating the truth, though doubting the absolute correctness as to the very large percentage of cases occurring during and after labor, while we believe that the percentage of those that happen before labor is too small.*

If eclampsia occurs in labor, it is usually in the first stage. If after labor, in the great majority of cases within a few hours, though a few or several days may intervene in others: even twenty-eight days have passed in a patient observed by Bailly, and fifty-eight in a case of Sir James Y. Simpson's. We

* In Herman's 12 cases, nine began before labor, two during, and one after labor (*London Obstetrical Society's Transactions*, vol. xxxiii. 1892).

may, with Vinay, question whether attacks first occurring more than two weeks after labor should justly be included under puerperal eclampsia. In the great majority of cases in which the disease happens in pregnancy the time from seven to nine months offers the greatest liability; nevertheless, cases have been observed at the sixth, the fifth, or the fourth month, even at the sixth week, and Tissier reported a case at the seventeenth day, and Prestat one in the second week.

Premonitory Symptoms.—The first attack may occur without warning, the patient apparently having been up to the seizure in good health. But usually there are precursory phenomena, lasting only a few hours or beginning a few days before. These phenomena are nausea and vomiting, restlessness, weariness upon exertion, mental irritability, headache, disturbance of vision, dizziness, muscular tremors, ringing in the ears, and severe epigastric pain. Delore calls attention to lumbago as a premonitory symptom observed in some cases, this symptom being the expression of renal changes. Special importance is, probably with justice, to be attached to three of these—namely, the epigastric pain, the headache, and the disturbance of vision—and therefore fuller consideration must be given them. The *epigastric* suffering is by no means a constant manifestation; but if it occurs, it is quite significant: according to Bailly, it rarely lasts more than a few hours, and when it becomes very severe and continuous one may almost be certain that the convulsive attack is imminent. Dyspnea is connected with epigastric pain, and is attributed to the poison in the blood, which, as will presently be seen, seems the essential cause of eclampsia. The *headache* is usually frontal, occupying the entire forehead, or it may be upon the one or the other side; rarely is it occipital. The *disturbance of vision* may be simply asthenopia or amblyopia or diplopia, or even absolute blindness; in one case we have seen loss of vision twenty-four hours before fatal eclampsia at the fourth month of pregnancy, and we have had a patient who became amaurotic during labor—it was a plural pregnancy, and she had had for some weeks albuminuria; the amaurosis continued several days after the delivery of living twins, and then spontaneously disappeared.

According to Vinay, if headache is accompanied by flashes of light, by ringing in the ears, by tingling and numbness of the lower limbs, the attack is at hand. In some cases, rare, however, an *aura* immediately precedes eclampsia. A patient of Olshausen's uttered her husband's name, and instantly the convulsions came. Another may have the sensation of falling, still another may utter a cry of terror, and others have been known to raise the arm before the face as if to protect it from a threatened blow.

If some of the premonitory symptoms that have been mentioned, such as disturbance of stomach, of vision or hearing, headache, numbness of the lower limbs, be observed in a woman who is edematous, if she has scanty urine, and, above all, if this contains albumin and casts, convulsions will surely come unless proper means are promptly used to avert them.

Phenomena of Eclampsia.—The patient lies fixed in position, while her eyes are apparently directed to some distant object; she has become uncon-

scious, and gives no attention to what may be said or done; in a few seconds the eyeballs move in various directions, soon become still, generally turned upward and to the left; the head, changing from side to side, finally remains directed to the right; the eyelids open and shut, the muscles of the nostrils and of the face move spasmodically, then the mouth is drawn toward one side; the trembling tongue may be thrust between the teeth; brief jerking movements of the limbs occur, the arms are pronated, the forearm flexed, the thumb firmly applied to the palm, and the fingers over it; the jaws become rigid, and if the tongue has protruded, it is bitten; respiration is arrested by tonic contractions of the muscles of the chest, and rigidity of the entire body and limbs is present. In from a third to half a second clonic convulsions ensue, the rigid state ceases, these convulsions involving the muscles of animal life, wave of disordered movement swiftly following wave; respiration returns, but it is stertorous, and moist bronchial *râles* are heard; the swollen face, which became "violet, livid, even black" (Jacquemier) during the tonic stage, gradually takes a less unnatural color; the noisy expirations drive out frothy saliva, often tinged or deeply colored with blood. The clonic convulsions, after lasting from one to five minutes, cease, their cessation being marked by an unusually deep inspiration. Coma concludes the drama, the patient remaining unconscious, and also insensible. The coma is the consequence of cerebral congestion, and the congestion is caused by pressure on the jugular veins by the convulsed muscles of the neck, and especially by the arrest of respiration during the tonic stage. The comatose condition may last from ten to twenty minutes, or even a longer time.)

During the convulsions expulsion of feces sometimes occurs—more rarely of urine and of the contents of the stomach. The body is covered with an abundant viscid perspiration. The pulse, which at the beginning of the attack was probably full and strong, is feeble and frequent during it, but becomes more natural in the coma. The clonic convulsions, while rarely lasting so long as five minutes, continued in a patient observed by Tarnier for twenty minutes. The return of the patient to consciousness is only gradual, and the time intervening between the first onset of the convulsions and the end of the coma is a complete blank in her memory.

Very rarely there is but a single attack, and the patient is restored to perfect health. Still more rarely death results from this attack; such a case has been recently reported:⁹¹ the patient was delivered just at the beginning of a broncho-pneumonia; at the end of nine days she had eclampsia, and died in forty-eight hours after the attack.

In almost all cases after an interval of half an hour, or even of several hours, the eclampsia recurs, and attack may follow attack with no restoration to consciousness—indeed, in grave cases the consciousness may not return after the first attack. The number of seizures may be very great; Kaltenbach refers to eighty in some cases, and Vinay says there may be more than a hundred. Winckel has seen but one case of recovery after eighteen attacks; but Vinay states that a patient recovered after twenty-six,

and Olshausen had six patients, having from twenty-two to thirty-six, who got well.

It is rare for the attacks to continue longer than forty-eight hours; indeed, the fate of the patient is usually determined within the first twenty-four hours, for if there are several attacks during this time, unmitigated in severity and undiminished in frequency, a fatal result is almost inevitable. Winckel first called attention to the progressive elevation of temperature with successive attacks, so that it may reach 102° or 104° F., and after death the thermometer marks a still higher degree. Investigations by others, especially by Bourneville, followed those of Winckel. Bourneville claimed that not only did the thermometer furnish important ground for prognosis, but by it only could puerperal eclampsia be differentiated from uremia. If the temperature of the eclamptic continued to increase, reaching a high degree,* the prognosis would be unfavorable, while a progressive diminution pointed in an opposite direction. The results of experience do not give absolute confirmation of this view, for though usually the temperature increases during the continuance of the eclamptic attacks, yet in some instances the danger may be imminent, death at hand, without such increase,† or the temperature may even be subnormal. So too in regard to the diagnosis between eclampsia and uremia: while it is true that there is in the latter a lessened temperature, there are exceptions‡ to the rule.

The urine of the eclamptic is usually scanty, contains albumin in large proportion, various casts, epithelium from the urinary tract, and blood-cells: in some cases there is complete anuria. Nevertheless, all albuminurics are not eclamptics; Hubert makes the number only 26 per cent., and Charpentier has collected 141 cases of eclampsia without albuminuria. The writer, a few years ago, had under his care a primipara who was attacked with eclampsia a few hours after labor, and the quantity of urine was not lessened, and showed only a faint trace of albumin.

The Influence of Eclampsia upon the Uterus and upon the Fetus.—In case eclamptic attacks occur in pregnancy, more especially in the latter weeks, in the majority of cases action of the uterus is excited and its contents are expelled after the fetus is dead. The death of the fetus may be followed by a disappearance of the eclampsia, and in case no uterine action has begun, the pregnancy may continue for a time, or even until term; meantime, if albuminuria has been present, this gradually ceases. In still other cases, by no means numerous, the fetus lives, the patient recovers, and the preg-

* Black states that in one case, untreated until the patient was moribund, he had found the temperature as high as 110° F. (*Transactions London Obstetrical Society*, vol. xxxii.).

† Rivière, referring to Bourneville's statement, remarks: "In several of our observations the temperature, carefully taken either during the attacks or in the intervals, was not elevated above the normal, or so slightly that it should not be considered" (*Pathogénie et traitement de l'auto-intoxication éclamptique*, 1888).

‡ Rivière (*op. cit.*), referring to this view, states that Bouchard ascertained that while uremia causes, in the majority of cases, slowing of calorification sufficient to produce a subnormal temperature, this sometimes fails, and there may be increase of temperature.

nancy is completed. Should eclampsia appear in labor, this is accelerated, and delivery may occur without the patient being conscious of it. The attacks are frequently excited by uterine contractions; the escape of the amnial liquor may be followed by at least a temporary cessation of the paroxysms.

The death of the fetus probably occurs in about 50 per cent. of cases as the consequence of maternal eclampsia. This death may result from the fact that the pregnancy ends before the child is viable, or be caused by placental hemorrhages, peculiarly liable to occur in albuminurics, or from asphyxia resulting from the deficient oxygenation of the mother's blood, or from the same poison that causes the convulsions of the mother. In several cases the child has been expelled dead and rigid: the writer met with an example of this kind more than thirty years ago, the mother attacked with eclampsia at the end of her pregnancy, and dying twenty-four hours after delivery; the rigidity was well marked; it seemed almost as if the chief joints of the fetal members were ankylosed. Some of the children are born hemiplegic; others, apparently in good condition at birth, are soon attacked with convulsions similar to those of the mother, and quickly perish, and the lesions are often those of eclamptic women (Vinay). A case of fatal encephalitis in the infant of an eclamptic woman, coming on soon after birth, has recently been reported.⁹²

Terminations of Eclampsia.—Eclampsia may end in death or in partial or complete recovery. A fatal result rarely occurs during the eclamptic attack from the long arrest of breathing—an acute asphyxia—caused by tetanic contraction of the respiratory muscles. More frequently the patient dies from gradual asphyxia, caused by pulmonary edema or congestion. Cerebral apoplexy is the cause of death in some cases: Olshausen's statistics,⁹³ embracing 200 cases, the general mortality being 25 per cent., include five deaths from this cause, while there were two other fatal cases presenting hematmata of the pia mater, and five with notable hyperemia of the brain and its membranes. Pneumonia is not an infrequent cause of death; and so, too, puerperal infection. It has been suggested that the occurrence of the latter is to be attributed to "a special receptivity for infectious germs;" but it seems to the writer more rational to regard this frequency as explained by the interference on the part of the obstetrician with the labor, either to induce or hasten it, and the local treatment employed for the arrest of post-partum hemorrhage, an accident to which the albuminuric eclamptic is peculiarly liable. Another cause of death is acute yellow atrophy of the liver. Finally, the profound toxemia, regardless of complications or consequences of the eclampsia, is the cause of death in some cases.

Mental defect and disorder may appear as consequences of eclampsia, making the recovery incomplete: amnesia represents the former, and insanity the latter. The amnesia may be temporary, or last for many weeks or months, and in some cases it relates only to recent events; in others the knowledge of years may be blotted out. Insanity occurred in 6 per cent.

of Olshausen's cases. In the majority of cases the albuminuria disappears in a few weeks, especially if it resulted from the kidney of pregnancy, but in others grave renal disease is manifested. Hemiplegia sometimes follows eclampsia, and is usually incurable. Disorders of vision may remain for some weeks, but, as a rule, are not permanent. Fortunately, complete recovery is the rule in eclampsia. The signs which indicate this happy result will be considered under the head of *Prognosis*.

Diagnosis.—Epilepsy presents the most striking resemblance to eclampsia—the same loss of consciousness and of sensation, the same series of tonic and clonic convulsions, succeeded by coma. But then the fact of pregnancy, the prodromata of eclampsia, the number of attacks, the condition of the urine, not albuminous or only slightly so in the case of the epileptic, abundant and not containing casts, and above all the previous history, would prevent doubt or confusion in diagnosis. The thermometer, too, may assist in the diagnosis, for the epileptic does not present a constantly rising temperature, while the eclamptic generally does.

Winckel states that a confusion of eclamptic convulsions with those caused by meningitis occurred to him once in a pregnant woman. He states that in the latter disease the attacks are seldom so general, do not return so regularly; they constitute gradually increasing irregular contractions of some groups of muscles. Moreover, fever usually precedes the attacks for some time; the patients have previously been forgetful and somnolent; yet the difference is by no means always marked. Hysteria belongs to one who has an hysterical history, and can only momentarily counterfeit eclampsia,* for there is often to be discovered "a method in the madness," the evidence of feigning; no profound loss of consciousness, if loss at all; there may be grotesque attitudes and expressions, but not the horrible grimaces of eclampsia; coma does not come, and the secretion of urine is not scanty nor does this fluid contain albumin.

Prognosis.—In general the eclamptic attacks that occur before labor are attended with the greatest, those after labor, the least, mortality. So, too, if the uterus can be emptied without violence and soon, the prognosis is improved. Dührssen⁹⁴ claims that if the uterus is relieved of its contents during profound narcosis, in 93.75 per cent. the eclampsia ceases. Charpentier, taking the statistics of German authors,⁹⁵ has shown that the mortality in 171 cases of eclampsia coming on after labor was 12.5 per cent. These facts will be especially considered in presenting the treatment. Referring to an individual case, if the attacks have been less than fifteen, if neither violent nor close together, if the coma is brief, if the temperature is not high, the pulse not frequent, if the secretion of urine be not greatly lessened, only slightly or not at all albuminous, there are good grounds for expecting a favorable issue. Opposite conditions indicate a doubtful or fatal result. "Of very unfavorable prognostic significance are complete anuria, profound stupor, loss of

* One of the acute observations of Coleridge was: "Hysteria may well be called *minima*, from its counterfeiting so many diseases—even death itself."

reflex irritability, paralysis, small frequent pulse, great elevation of temperature, jaundice" (Kaltenbach).

The mortality is certainly less than that given by Pajot, 50 per cent., but even Bailly has made it 42 per cent., and in some recent statistics the lowest percentage given is 19.38, and the highest 36.50: Kaltenbach gives 30 per cent. of deaths.

Post-mortem Appearances.—The brain in many cases presents no material lesion, but in other instances there is great anemia with edema, and flattening of the cerebral convolutions; less frequent is hyperemia, though sometimes this may be so great that rupture of the vessels occurs and apoplectic clots are found. In rare cases the kidneys have been found absolutely normal, but oftener present those changes characteristic of the kidney of pregnancy, and next of parenchymatous nephritis. Kaltenbach observes, on the one hand, that frequently the changes in the kidney are not significant, and are not at all in proportion to the gravity of the disease, as has recently been pointed out by Virchow; and, on the other hand, there may be grave alterations, chronic parenchymatous and interstitial nephritis, without eclampsia having occurred. But it would not be rational to conclude, from the fact that the kidneys show slight or no changes, that their function may not be seriously disturbed.

Edema of the lungs is frequently found, less often congestion, with apoplectic centres, and finally the evidences of pneumonia—deglutition-pneumonia—may occur. Vinay regards lesions of the liver as presenting as great an importance as those of the kidney, and considers them as more frequent and more characteristic. The liver may be completely disorganized, and present the lesions of acute yellow atrophy in some cases, while in others it is increased in size. It presents, under these circumstances, capillary ectasie and hemorrhagic centres at the periphery; sometimes necrosis is found, and, again, hemorrhages beneath the capsule. It is quite rational to admit, as several authors have done, that in some cases the eclampsia should be recognized as cholemic rather than renal.*

Etiology.—It is proper to divide the causes of eclampsia into (1) Predisposing, (2) Exciting, and (3) Essential.

1. *Predisposing Causes.*—Primiparity holds an important place among predisposing causes. The statistics of the Philadelphia Hospital from 1874 to 1889 include 2655 deliveries with nine cases of eclampsia, and all the nine were primiparæ. Other statistics make the disease from three to seven times more frequent in primiparæ than in multiparæ. This increased liability has been attributed to the more frequent occurrence of albuminuria in a first pregnancy, the greater intra-abdominal pressure, and excessive nervous exci-

*Massen makes the following statement as to post-mortem appearances in women dead of eclampsia: In 19 cases there was acute interstitial or parenchymatous nephritis, sometimes with destruction of the epithelium of the tubes in the cortical substances; in 5 cases interstitial hepatitis; in 3 necrosis centres in the hepatic parenchyma; the uterus and tubes presented interstitial lesions; the brain, dilatation of capillaries; the heart, a parenchymatous myocarditis ("Proceedings of the St. Petersburg Obstetrical Society," *Annales de Gynécologie*, 1893).

ability: the longer labor is also a cause. If the primipara be old, the liability is increased.

Pluriparity predisposes to eclampsia. In Olshausen's statistics sixteen out of two hundred gave birth to twins. Here, again, we have similar or rather the same factors which are present in primiparæ and have been mentioned. There must also be borne in mind that in plural pregnancy additional work is thrown upon the eliminating organs of the mother, but this will be presented in considering the essential etiology of the disorder. When the pelvis is narrow or the child's head of unusual size, the eclamptic attacks are more likely to occur than in opposite conditions. Eclampsia is more frequent, too, between the ages of twenty and thirty: here, probably, the true factor is primiparity.

Hereditary influence has rarely been observed. One of the most striking cases of this influence has been recorded by the late Dr. George T. Elliot:⁹⁶ The patient's mother had given birth to four daughters, and then died of eclampsia at the birth of a son. Of these daughters one died of eclampsia at the sixth month of her first pregnancy, a second, after having two miscarriages, died of eclampsia in her third pregnancy, the third had eclampsia about the sixth month, and recovered; while the fourth was attacked in the eighth month, and perished after artificial delivery. Löhlein states that a patient in Schroeder's clinic died of eclampsia, and her two sisters had convulsions in their first labors.

Independently of heredity, as manifested in the cases quoted from Elliot, and also independently of the mental distress referred to, as predisposing causes, it will readily be admitted that the susceptibility of the nervous system greatly varies in different subjects, and that some from excessive irritability may have an eclampsia liability. Of course such condition alone cannot produce the disease, but it may greatly assist in its production. Kaltenbach has said that a generally-contracted pelvis corresponds usually with an infantile *habitus*, which is shown in an increased irritability of the nervous centres; yet, according to Wiedow, such pelvis must sometimes be looked upon as indicating degeneration. Thus predisposing causes may be combined in action.

The mental condition may be a predisposing cause, and thus unmarried women, suffering with shame and anxiety, are more liable.

What shall be said of the opinion expressed some years ago by Johns of Dublin, that unless the vertex presented there was little liability to eclampsia? When it is proved that there is in proportion to the entire number of the various presentations an undue predominance of eclamptic cases in which the vertex descends first, the action of this alleged cause would be justly considered. It may be of interest, in connection with this view of Johns as to the etiology of eclampsia, to quote a sentence from Denman's "Introduction to Midwifery," as showing the possible first inspiration of the view: "I was for many years persuaded that convulsions only happened when the head presented; but experience has proved that they sometimes occur in preternatural presentation of the child."

2. *Exciting Causes.*—When essential and predisposing causes combine, the exciting cause of the convulsive paroxysm may be in itself a very slight one, just as the electric spark or a lighted match causes explosion of a powder magazine, or careless handling that of dynamite. Thus the outbreak of eclampsia may occur from touching the os uteri, from pressure of the hand upon the abdomen, from distended rectum or bladder, from a uterine contraction, or from movements of the child.

3. *Essential Etiology.*—Various theories as to eclampsia which once prevailed—the nervous theory, that which made the disease the result of cerebro-spinal congestion, the uremic theory and its derivatives—have passed away. True, Herff⁸³ contends for the disease resulting from the physiological irritations of pregnancy, but this is given by him as only one of the causes. True, too, that the term *uremic* is still applied by some to these convulsions, but no intelligent physician now claims, as was done by Wilson and others, that urea retained in the blood is the cause of spasms: it is probably unfortunate that any continue the use of the word in this connection, for etymologically and as originally employed it is now misleading.

The theory which makes the essential cause toxemia—not one, but several different poisons, it may be, concerned—is now generally upheld. So, too, the toxemia, while usually associated with renal failure, and dependent upon it, does not in all cases have such association and dependence, for the disease caused by the toxemia may occur without renal disorder; moreover, it is a question in some cases whether this disorder is not the consequence rather than the cause of the toxic condition. Admitting the microbial theory of the origin of the disease, now held by a few—a most improbable supposition—it could only explain the toxic condition of the blood, and could not invalidate the opinion that the immediate cause of the convulsions is such condition.

As stated by Kaltenbach, the theory of blood-poisoning is sustained by the clinical history of the disease and by post-mortem appearances. "The prodromata—gastric and cerebral symptoms—the rapid occurrence of serious disturbances in the action of the brain, the post-mortal increase of temperature, the nature and frequency of nervous disorders that follow, and which find their analogy in the neuroses consequent upon typhus and diphtheria, probably caused by toxalbumins, are scarcely to be explained unless by the theory of blood-poisoning. The nature as well as the extent of the anatomical lesions also corresponds with such theory." Admitting the toxemia, the question naturally arises, What is the source of the toxic agent or agents? Are we to concede the truth of the position taken by Rivi re, for example, that autointoxication is the true answer? Bouchard has said⁸⁷ that man is constantly menaced by poisoning; he labors each instant for his own destruction, makes incessant attempts at suicide; nevertheless, this intoxication is not realized, for the organism has multiple resources to escape it. The liver plays an important part in the destruction of poisons, and elimination by the skin, by the lungs, by the kidneys, and by the intestines assists in the protection of life from poisoning: the most important agents in elimination are the kidneys.

The urine, according to Bouchard's investigation, contains several toxic principles. Further, it has been found by experiment that the toxicity of this secretion is greatly lessened in the eclamptic, while that of the blood-serum of the same subject is notably increased. It is not the failure of the kidneys to eliminate urea that determines the convulsions, for the non-pregnant woman may have anuria for several days without eclampsia, and while the amount of urea eliminated by the woman in gestation each twenty-four hours is increased nearly one-third, there must be arrest of elimination for more than ten days in order that intoxication become possible. We can readily understand that if the poison or poisons which produce eclampsia are retained in the blood, renal inefficiency or failure may add to the gravity of the condition, in that were the kidneys healthy they would cast out the offending matter. According to Bouchard, the kidneys are capable, when sound, of eliminating infinitely more toxic material than they habitually do; nevertheless, there are limits, and if the quantity of poison is such, notwithstanding their integrity, that they cannot accomplish their task, accumulation is produced and intoxication results. Thus in the etiology of eclampsia the non-elimination by the several emunctories mentioned must be placed at the very beginning of the trouble—and the toxic matter may be maternal in origin. Yet may not the fetus, and even the placenta, have a part in the etiology of the poisoning? The non-pregnant woman may have her abdomen as greatly distended by an ovarian tumor as from plural pregnancy at term, and she does not suffer from eclampsia. Often if the fetus dies the eclampsia ends. So, too, the eclamptic attacks are more frequent as the labor occurs and progresses; uterine contractions may cause new poison to pass into the maternal blood from the fetus and placenta. It seems, therefore, at least not improbable that from the latter source a part of the poison producing eclampsia is derived.

The microbial theory recognizes infection, attributing, however, the poisoning, not to maternal life-processes, poison-producing, and failure of poison-elimination, but to the action of microbes, toxins being formed by these. This theory was first suggested* by Delore ten years ago. A few have, from experimental studies, sustained the theory, but the majority of investigators have rejected it. Moreover, in order to explain the entrance of microbes, the hypothesis of a previous endometritis has been assumed. But as the eclamptics are, in the great majority of cases, primiparæ, who rarely are subjects of endometritis, while multiparæ, in whom the disease is not infrequent, are comparatively seldom eclamptic, the microbial theory must be regarded as very improbable.

It may readily be admitted, as Kaltenbach has said, that the pathogenesis of eclampsia is by no means perfectly clear. Winckel, while accepting the toxemic theory, remarks that there are different degrees of this condition, probably different poisons, or a poison originating from different causes.

* Corre, when the hypothesis was first presented, pleasantly remarked (*Manuel d'accouchement et de pathologie puerpérale*): "We have the microbe of tetanus, that of eclampsia, and soon, doubtless, will have those of hysteria, of epilepsy, of meningitis, etc."

Halbertsma attributes the eclampsia chiefly to lessened excretion of urine resulting from compression of the ureters. Stumpf⁹⁸ believes that in some cases under abnormal decomposition a non-nitrogenous substance, probably acetone, is produced, and this in its elimination causes irritation; inflammation of the kidneys has a destructive effect upon the coloring matter of the blood; diabetes mellitus and acute yellow atrophy of the liver, with the formation of tyrosin and leucin, follow, and coma and convulsions. Herrgott⁹⁹ has recently contributed an elaborate paper upholding the microbial theory. Chambrelent¹⁰⁰ observes that eclampsia appears to be due to a poisoning by a toxin, but investigations so far fail to prove the presence of a really pathogenic bacillus. Von Herff regards eclampsia as a complex of symptoms which may be produced by various causes, but the origin is especially in the psycho-motor cerebral centre and in the subcortical ganglion-cells: a change of irritability of this cerebral centre is essential, "*eklamische Labilität*," and is either inherited or is acquired through intoxication, infection, pathological conditions etc., or, finally, it is the consequence of physiological gestation-irritation. Dührssen finds the cause of eclampsia in retention of creatin and creatinin in the kidneys; sometimes there is a nephritis resulting from accumulation of urine resulting from pressure upon ureters. The creatin and creatinin accumulate in the vessels of the cerebral cortex, causing convulsions and coma. The disease may also be caused by bacterial products, and in a few cases it is purely reflex, resulting from great distention of the uterus or other violent irritation of nerves of the genital tract.

In regard to some of these views one is tempted to repeat the remark of Dr. Samuel Johnson: In the arena of conjecture all men are equal whose opportunities for information are equal.

Treatment.—Vinay justly observes that there are malignant cases of eclampsia in which death is inevitable, all means of cure failing. This fact should be borne in mind in considering not only the value of therapeutic agents, but also the results of personal experience. There are no specific remedies in this disease, and no one plan of treatment to be constantly pursued.

Prophylaxis.—The first points in prophylactic treatment are the avoidance of constipation and securing free action of the skin and kidneys. The first is accomplished, as advised by Winckel when there is any notable albuminuria, by the administration each morning of a pill composed of extract of aloes and extract of colocynth, in sufficient quantity to cause free, watery evacuations. The hot bath is the best means for producing activity of the skin; this bath should have a temperature of 100° F., the patient to remain in it at least fifteen minutes, and upon coming out of it be wrapped in warm blankets, drink a glass of hot milk, and remain in a warm room for two hours: abundant perspiration will thus result. If an absolute milk diet is not directed, at least milk should be the chief food; Winckel allows the sparing use of meat and vegetables. The diuretic action of the milk may be promoted by alkaline mineral waters. For the albuminuria Duff¹⁰¹ recommends

one drop of nitroglycerin three times daily, and Vinay speaks highly of chloral. The latter refers to a patient, a primigravida, having at the end of the eighth month 22 grams of dried albumin in the urine in twenty-four hours, who took during the ninth month 120 grams of chloral, or 4 grams per day, and was delivered at term of a living child, no convulsions occurring: in most cases he advises 3 grams daily, or 45 grains. He also states that when the albumin is abundant, and headache, irritability, restlessness, vertigo, disturbance of vision, etc. are present, chloralization of parturients is of the greatest value; from the beginning of the pains from 4 to 6 grams of chloral are given by the mouth, and the patient soon sinks into a profound sleep, uninterrupted but at the moment of contractions.

In grave and persistent albuminuria, no benefit having been obtained by hygienic and medical means, and eclampsia threatened, the artificial interruption of the pregnancy may be clearly indicated. In case the convulsive attack occurs, the immediate duty of the practitioner is to prevent the patient from injuring herself; the greatest liability is that she may bite her partially protruded tongue, which, therefore, should be held back by means of a napkin stretched between the teeth and grasped on each side. Kaltenbach advises, for this purpose, inserting between the jaws the handle of a spoon wrapped with gauze.

Of course the patient is prevented from injuring herself by striking against hard objects, or even falling out of bed during clonic convulsions—a possibility, but not a probability. If after a convulsion the tongue falls back, arresting respiration, it must be drawn forward. Kaltenbach emphasizes the importance of cleansing the pharynx by means of small sponges with a handle, to prevent the entrance of the secretions from the mouth and pharynx, mixed with bloody slime, into the lungs, stating that many patients die, after recovery from the convulsions, in consequence of *Schluckpneumonien*, or deglutition-pneumonia.

Is she to be bled? Doubtless our fathers were wrong in making venesection the common remedy in eclampsia, but their sons are equally wrong in entirely rejecting it. Though Winckel and Martin condemn it, though indeed it has little professional support from great authorities in general, yet we find Kaltenbach wisely, as we believe, saying that in strong, plethoric women, with great cyanosis, bleeding has undoubtedly a favorable effect. This bleeding removes a certain amount of poison from the circulation; the removal, too, is instant, and it further removes from the convulsive centres the poisoned blood by restoring contraction of the small vessels as claimed by Peter. We believe, therefore, that bleeding in some cases of eclampsia is rational, and rests upon a sound clinical basis. (See especially the statistics of Charpentier upon this point.) Of course it is only in exceptional cases that this treatment is indicated.

The administration of chloral by the rectum is generally adopted; Winckel employs 1 to 2 grams of chloral thus, repeating the dose after each attack until 12 grams or more are administered in twenty-four hours; Plant suc-

cessfully used 150 grains, or about 15 grams, in the same period. Clark in America (Oswego, N. Y.) and G. Veit in Germany are the most prominent advocates of morphia hypodermatically, and each uses what many would regard as heroic doses. Olshausen employs one-third of a grain, increasing to nine-tenths, and only resorts to chloral when morphia cannot be employed: he has given 11 to 12 grains of morphia in four days. But all have not been as successful in using the morphia treatment as Veit, only two deaths in sixty cases; and moreover a fatal narcosis of the infant, if not of the mother, has sometimes been observed.

Anesthetic inhalation, chiefly of chloroform, is generally recommended, though Olshausen reserves it for exceptional cases, and Kaltenbach objects to the protracted narcosis with chloroform, for, on the one hand, it readily leads to fatty degeneration of the heart and other organs, and, on the other hand, impairs the activity of the kidneys; on the contrary, Vinay refers to patients having been kept under its influence six, ten, or even twenty-four hours. The potassic bromid may be rejected because requiring large doses, slow, uncertain, and feeble in its action; moreover, according to Bouchard, the potash is the most toxic of mineral salts. Pilocarpin is a remedy condemned by Braun, Fordyce Barker, and, more recently, by Winkel, Kaltenbach, and Vinay. Purgatives are generally recognized both from theoretical reasons and from experience as important. In addition to those previously mentioned, elaterium and croton oil, administered by the mouth, and infusion of senna, with the sulphate of soda or of magnesia, by the rectum, are frequently employed.

Professional evidence seems conclusive as to the great value of tincture of veratrum viride, first used in 1859 by Dr. Baker¹⁰² of Eufaula, Alabama, and long a favorite remedy with practitioners of the South and West of the United States. The method of administering is hypodermatic, and the dose, according to Jewett,¹⁰³ is from 10 to 20 minims; the smaller dose repeated in half an hour will doubtless suffice in the majority of cases. Dr. Jewett asserts that experience seems to justify the statement that no convulsion will occur while the patient is sufficiently under veratrum to hold the cardiac pulsations below sixty to the minute. If the pulse is not sufficiently reduced by the first injection, a second is given in thirty minutes: five-minim doses at longer intervals are used to keep up this lessened frequency of the pulse.

The Cesarean operation performed after the mother's death has in a very few instances saved the life of the child, but Halbertsma¹⁰⁴ has proposed, and several times done the operation, to save not only the life of the child, but also that of the mother, in grave cases of eclampsia. The entire number of operations by him and by others is 14, but as two of the patients were dying, the number is reduced to twelve; of these four died; that is, the operation gives a mortality of a little more than 36 per cent. Recognizing that the subjects operated upon were in imminent danger of death, the result does not seem discouraging.

Maygrier⁹⁹ has reported the case of a primipara who had eighteen attacks of convulsions; she was treated by venesection, and then, by a sound passed

into the stomach through the nose, 150 grams of milk were introduced every hour; anuria, which was present, was almost immediately relieved, and the patient recovered.

Porak and Bernheim¹⁰⁵ advise in every case in which the urine is suppressed or is scanty and dark colored that salt water should be used hypodermatically, to promote diuresis and thus elimination. A liter of sterilized warm water containing 7 to 7.5 grams of chlorid of sodium is introduced into one of the buttocks, the skin having been first disinfected, and either a needle or a siphon employed: twenty minutes is required for the operation; the fluid injected has a temperature of 88° to 90° F.; the results have been quite satisfactory.

There is a general agreement of the profession that if eclampsia occur in labor or labor come on during it, delivery should be effected as soon as possible without violence. So, too, the majority agree that eclamptic attacks that do not yield to appropriate treatment furnish an indication for ending the pregnancy. Dührssen⁹⁴ has gone further, reviving *accouchement forcé*, which in this day of antiseptics and anesthetics is by no means the perilous proceeding it once was; he does not shrink from ending the pregnancy, even when the child is not viable, in eclampsia and in the primigravida when no efforts at labor are made, overcoming obstacles presented by the cervix or by the perineum and vulva with incisions, so as to ensure rapid delivery. This method has not met with the approval of Olshausen, for example; it has received from Charpentier a searching and severe criticism,¹⁰⁶ and he declares it dangerous and that it ought to be absolutely proscribed. In his conclusions Charpentier states that the induction of premature labor should be reserved for some exceptional cases in which the medical treatment has entirely failed. He also gives the following statistics of mortality in eclampsia: After spontaneous labor, 18.96; after artificial labor, 30.04; and after *accouchement forcé*, 40.74. Goldberg gives the following statistics in eclampsia: 5 times labor was induced, 4 deaths; 6 dilatations of os by incisions, 4 deaths.

Haultain¹⁰⁷ reported three cases of eclampsia successfully treated by the induction of premature labor; he dilated the cervix with the fingers, dilatation sufficient to apply the forceps being accomplished in from sixty-five minutes to an hour and a half, and then the gentlest traction is sufficient to cause the head to act as a most efficient dilator. All the patients recovered, and two of the children lived. Should eclampsia come on after labor, chloral is the most important remedy; in many cases, however, veratrum viride has proved successful. Milk diet is important in all cases during convalescence.

Hyperemesis.—Excessive vomiting in labor is very rarely seen. Should it occur, however, its injurious effect is shown by weakened uterine contractions and by early exhaustion of the patient.

Etiology.—Naegele and Grenser,¹²² who find the immediate cause of hyperemesis in extraordinary sympathetic excitement of the nerves of the stomach, state that it is most likely to occur in nervous, feeble persons, in the chlorotic, and in those who have previously been subject to gastralgia and to hyperesthesia

of the gastric nerves. Hyperemesis may result from excessive distention of the stomach by food or by fluids. These observers refer also to a moral impression as sometimes a cause.

Treatment.—Usual means should be employed to arrest the vomiting: if it results from irritating matter in the stomach, whether food or secretions, copious draughts of warm water should be given. Sinapisms or the application of ether spray to the epigastrium, and the hypodermatic injection of morphia, will be employed; carbonic-acid water or champagne may be useful. But it is of the greatest importance that the delivery, whether manual or instrumental, shall take place as soon as practicable.

Hemorrhages.—Discharge of blood outside the genital sphere, such as epistaxis, hematamesis, hemoptysis, is occasionally seen in labor. Epistaxis, unless excessive, is to be regarded not as a complication of labor, but rather as a salutary condition relieving congestion of the head. If pulmonary or gastric hemorrhage occurs, it has been recommended that the patient should sit rather than lie upon the bed. Ice, cold acid drinks, muriated tincture of iron, and in pulmonary hemorrhage small doses of ipecacuanha, as advised by Graves, may be useful. In either form of the disease, if grave, prompt delivery is indicated. If the os is not sufficiently dilated to permit delivery with the forceps or by podalic version, *accouchement forcé* has been recommended. A case of rapidly fatal pulmonary hemorrhage in a woman at term has been reported by Budin.²⁹ The labor had not begun, and soon after death the Cesarean operation was performed and a child extracted that lived a few hours, and then perished with trismus.

Hernia.—Several instances of hernia causing dystocia are recorded. For example, Smellie's³⁰ case, No. 63, was one of crural hernia on the left side, the patient suffering from it during her entire pregnancy. In labor the hernia was forced down during every pain and gave her great uneasiness. Smellie says: "The labor being pretty far advanced when I arrived, I took the opportunity of reducing the hernia upon the cessation of the pain, pressing my fingers upon the part, and directing her to lie on her left side with her left thigh close up to the abdomen—a position which favored its keeping up and prevented the anguish which retarded the labor. She was accordingly safely delivered."

Winckel published a case in which there was a left labial hernia the size of a man's fist. In the second stage of labor, while an assistant held back the mass, the forceps was applied. Reposition was made after the labor, and retention was secured by a truss. He also saw a congenital left ovarian hernia in a parturient. The ovary, the size of a walnut, was irreducible, was not especially painful, and presented no obstacle to birth.

Smellie narrates two cases of perineal hernia. Of the one of these cases seen during labor he states: "The hernia was, however, reduced by opening the os externum, introducing my hand into the vagina, and pushing the intestine above the os sacrum." Spiegelberg, in describing vaginal enterocele, states that the hernia is almost always found at the posterior vaginal wall, and its

contents are usually formed by loops of small intestine, rarely by loops of the large intestine. Smellie reported a case, occurring in the practice of Mr. Stubbs, in which the vagina and the pelvis were filled by a tumor which probably proceeded from the intestines being pushed down at the back part of the vagina. The tumor was reduced by pressure, and the head immediately descended into the pelvis, the forceps then being applied. Dr. Hirst³¹ collected 27 cases of vaginal enterocele complicating pregnancy and labor. The hernia was posterior in all except two cases. Such a hernia existing, uterine contractions may cause it to descend so low that it partially protrudes from the vulva and presents a serious hinderance to birth. The tumor is soft and compressible at the beginning of labor, and the percussion sound, according to Müller,³² plainly indicates its character. Reposition, as successfully performed in the case reported by Smellie, is still the essential in treatment, the labor being ended by the forceps or, in case of pelvic presentation, by manual extraction.

Eventration.—When diastasis of the recti muscles occurs in an abdomen greatly distended by pregnancy, part of the uterus protrudes in the interval. This condition gives rise to inefficiency in the action of the abdominal muscles in the second stage of labor. The remedy will be found in a properly-applied bandage and in keeping the patient upon her back during the expulsive period.

Displaced Kidney.—Winckel¹¹² collected six cases of displaced kidney in parturient women. He refers to the fact that in this condition hinderance to labor may result from the organ entering the pelvis, thus materially lessening the size of the pelvic cavity. He advises, after replacement, as the best means of retention, having the patient lie upon the opposite side.

Tumors of the Rectum.—Jacquemier¹¹³ states that in some cases hardened feces, resulting from long constipation or from foreign bodies such as the seeds of cherries, have been an obstacle to expulsion of the fetus. Winckel says that hard fecal masses pressed into a small pelvis may hinder the entrance of the head, cause an unfavorable position or prolapse of a member, render the examination difficult, and produce anomalies of the pains. He quotes the case of Madurowicz-Rosner, in which, the child being transverse, the examination, because of the fecal mass, was very difficult and turning was impossible, decapitation being employed.

Such an accumulation should be washed out, its removal being assisted by mechanical means such as the handle of a spoon. McClintock, in one of his notes to the Sydenham edition of Smellie's *Midwifery*, says: "I have seen the rectum distended with such a mass of hardened feces that suppositories and enemata were utterly useless to effect their removal, the anus being dilated to the size of a florin by the fecal accumulation within. Here direct mechanical means must be employed to dislodge and extract the scybala with which the gut is blocked up. This having been accomplished, then enemata of turpentine, soap, and water may advantageously be employed to clear out the lower portion of the colon and to stimulate its peristaltic action." Cruveilhier, according to Jacquemier, published a case in which the expulsion of the fetus

was prevented by a cancerous tumor of the rectum. He successfully ended the labor by the forceps.

Relaxation and Rupture of the Pelvic Articulations.—In pregnancy the pelvic symphyses are swelled and softened, especially in the latter months of gestation. Budin has shown that at this time motion may be detected between the pubic bones. The physiological condition of softening may by excess become what is known as "relaxation of the joints," manifesting itself by pain at the articulation concerned and by more or less interference with locomotion. In rare instances occurring in labor there is an actual separation of the bones, a diastasis known as "rupture of the joint," the previous relaxation predisposing to this accident. Vinay¹¹⁴ believes that in cases of great relaxation of these articulations articular or periarticular inflammations (arthritides) complicate the condition. Schauta¹¹⁵ quotes the case observed by Gmelin, in which the autopsy showed (death having followed Cesarean section) that the pubic bones were separated 1.5 centimeters by an accumulation of yellowish serum at the place of the synovial cavity. In some cases there has been found inflammation of the cartilage, causing abnormal softening of the joint. Osteomalacia predisposes to rupture of the joints, this accident being very rare in the rachitic pelvis. Trousseau,¹¹⁶ who met with several cases of this disorder, and who has admirably described it, refers to one patient in whom the separation of the pubic bones was so great that the end of the index finger could be interposed. The late Fordyce Barker¹¹⁷ presented the subject in his usual clear and scholarly manner. Snelling's monograph¹¹⁸ is of course valuable. In the American edition of Denman,¹¹⁹ edited by Francis, two cases of this accident are reported by its author and two by its editor.

Pelvic contraction, great size and solidity of the fetal head, and unfavorable position have been mentioned as causes of rupture of the pelvic articulations. In one instance this accident seems to have resulted from the remarkable development of the trunk of the child, thus preventing its entering the pelvis, the forceps being required for delivery. In many cases the lesion has been attributed to the forceps, but it would seem more rational to regard the condition requiring instrumental delivery as the more important factor. Havajewicz¹²⁰ found that in 23 cases of separation of the symphysis forceps had been used in sixteen. In one of three cases reported by Remy¹²¹ the forceps was used, but in the other two the delivery was spontaneous. The direction in which traction is made with the forceps may be a cause, as when a part of the force is exerted in the axis of the birth-canal, while the rest of the force acts upon the pelvic girdle, especially at the pubic joint: nevertheless, the accident has occurred when Tarnier's axis-traction forceps was employed.

Ulsamer¹²² believed that rupture of the pelvic articulations from the forceps was much more frequent than was reported. He states that sometimes these ruptures are undiscovered, and sometimes they are kept secret, for the public is disposed to attribute the injury to the exercise of great force, although it has been proved that separation of the pelvic joints has followed the skilful use of the instrument, moderate force only being exerted; it may occur also

in spontaneous delivery. Ahlfeld in 1875 collected 100 cases of lesions of the pelvic joints, and in 1888 Schauta¹¹⁸ added 13 cases. Dührssen¹²³ has given 33 cases in which suppuration in the joint followed the injury. The 23 cases of Havajewicz and the 3 cases of Remy have been mentioned above.

When rupture of a pelvic joint occurs in labor, it is accompanied by sudden and violent pain in the joint, the patient being conscious, it may be, of a serious tear at the painful part, and the instant yielding of resistance, so that the presenting part rapidly advances. Moreover, a "crack" is heard not seldom by those near the patient. Sometimes, as in a case of Remy's, the labor ends without any indication of the injury, which is made known in some movements of the patient a short time afterward, there having been a silent rupture. According to Schauta, the accident most frequently involves the pubic and the right sacro-iliac articulation; then the pubic and the left sacro-iliac articulation. Rarely are the two sacro-iliac articulations affected without the pubic.

Direct examination of the pubic joint with two fingers or with the thumb and finger, one external and the other internal, will detect the injury. Further, the lower limbs, the patient being recumbent, will be everted. Trousseau called attention to the fact that "loosening of the pelvic symphyses" may be mistaken for disease of the spinal cord; and Remy remarks that "relaxation of the symphyses may involve functional impotence of the inferior members so pronounced that it may be believed there is a real paraplegia." Should the injury not be detected at the time of its occurrence or while the patient is in bed, it is recognized when she gets up and attempts to walk; if she succeeds, she, as Trousseau states, waddles, dragging one leg after the other and leaning greatly to the right or the left according to the foot she advances. Barker found that one of his patients could stand with comparative ease resting upon either leg, but could not balance herself upon both legs at once. If this accident occurs in labor, it is important to redouble antiseptic precautions, so that all danger of infection shall be averted so far as possible. If suppuration follows the injury, it is essential, as urged by Dührssen, that the purulent collection shall promptly be evacuated.

In one of the 13 cases given by Schauta the urethra was torn, and in another the bladder and the vagina. Four of the women died, but perfect recovery occurred in the others, save one who was bedridden, at the end of twelve months. The period of recovery varied from a few weeks to several months. In the case occurring to Havajewicz death followed on the nineteenth day, delivery having been made with forceps. The child, which was unusually large, perished half an hour after birth. In Dührssen's 33 cases of suppuration following rupture only seven recovered of twenty-four treated without incision, while of nine in which this treatment was employed all recovered.

The essential treatment of rupture or of great relaxation of the pelvic articulations is a firmly-applied bandage encircling the pelvis. "A girdle requires to be placed around a pelvis which has its staves separated. It is necessary to supply the temporary deficiency of intrinsic contention by an

extrinsic contention—that is to say, by the tight application of a bandage in such a way as to bring into contact the separated surfaces of the symphyses” (Trousseau). Most authorities * agree that a towel answers well for a pelvic girdle. The union of the joint may take place in from ten to fourteen days, but sometimes several weeks or even months are required.

Diseases of the Heart.—Cardiac disease is not uncommon in pregnant women, the most frequent form being valvular, the mitral valve being oftenest involved. The longer the lesion has existed and the more incomplete the compensation, the greater the liability to premature arrest of the pregnancy. This accident was observed (Vinay) in ninety-two of 220 cases, according to the statistics of Courréjol united with those of Porak.

The question of the interruption of pregnancy is determined by the condition of the patient. Fehling¹¹⁵ includes among the indications for inducing premature labor chronic bronchitis with great pulmonary emphysema and insufficiently compensated cardiac disease. Kaltenbach, too, makes uncompensated valvular disease of the heart an indication. Vinay¹¹⁶ states that in the severe forms marked by gravido-cardiac accidents, when bronchitis is united with pulmonary congestion and edema, and there often supervene visceral congestions, anasarca, and ascites, and the dyspnea is constant, preventing nourishment and sleep, energetic intervention becomes necessary. “Peter insists upon the good effects of bleeding, which is immediately useful in calming the distress and dyspnea. There may be added inhalations of oxygen, subcutaneous injections of caffeine and ether, infusion of digitalis or digitalin. But it often happens that the disorders of compensation cannot be ameliorated by medical treatment, and the life of the patient is in peril from increasing dyspnea and the cardiac asthenia; it is then necessary to induce labor.” In a recent valuable monograph by Allyn¹²⁴ the author states that labor should be induced when dangerous pulmonary symptoms persist in spite of suitable treatment; he further advises bleeding before labor is induced. Winckel regards induction of labor as uncertain in its effect upon the disease of the mother, and says that it ought to be restricted to the severest cases.

When labor occurs it is agreed that anesthesia may properly be employed, chloroform being preferable to ether, and that the travail should be ended with as little exertion on the part of the mother as possible. If the forceps is used, it is advised that extraction be made slowly, to avoid sudden lowering of the intra-abdominal pressure. To compensate for this lessened pressure following birth, Lohs and Fritsch¹¹⁵ recommend bags of sand upon the abdomen.

Dr. Webster¹²⁵ advocates chloroform as the anesthetic in labor; he states that occasional *hypodermics* of ether may be required, and especially recommends nitrite of amyl as first tried by Fraser Wright, capsules containing 4 or 5 minims being broken and the drug being held to the patient's nose. “It

* It is remarkable that Meigs should have found “every attempt at bandaging a failure, on account of the impossibility of well adjusting and properly retaining a bandage in place in this particular part of the body, so that I am obliged to conclude that the best thing that can be done is to go to a protracted rest in bed.”

is also useful in opposing the tendency to chloroform syncope." "As the child is delivered the nitrite of amyl is of great value in neutralizing the increasing strain on the heart due to the additional blood thrown out of the uterine circulation as a result of the uterine retraction which follows delivery." He further advises that during the third stage of labor artificial detachment of the placenta be made by a hand passed into the uterus, securing a certain amount of hemorrhage, and warns against the delivery of the placenta by the Credé method, and also against the administration of ergot.

Diseases of the Brain.—Winckel states, referring to meningitis in pregnancy, that when labor begins the condition is aggravated and the severe headaches may end in convulsions, but the urine is free from albumin. He refers to Hecker's case of tubercular meningitis, the restlessness of the unconscious patient becoming so great with the occurrence of labor-pains that the labor was artificially ended. Of the 35 cases of paralysis collected by Churchill,¹²⁶ in twenty-three the attack occurred during pregnancy, and in twelve either during or after labor. In this number there were thirteen cases of hemiplegia, partial or complete, occurring before or during labor: these cases were obtained from Lever, Stokes, Crosse, Simpson, and McClinton. Imbert-Gourbeyre in his well-known monograph reports several cases of hemiplegia occurring in pregnancy, and he states that in more than half the cases *des paralyses obstétricales* the paralyses are manifested during pregnancy, and that in two-thirds the patients are hemiplegic. In 1872, Charpentier¹²⁷ collected 172 cases of puerperal paralysis, and of these there were fifty-seven hemiplegias to forty-five paraplegias. The causes of hemiplegia were chiefly cerebral lesions and failure of renal action.

In quite a large proportion of cases, if the hemiplegia occurs during pregnancy, either premature labor or, in some cases, abortion occurs. In these patients there is usually albuminuria. In very many of the cases a fatal result occurs, twenty out of fifty-seven dying, according to Charpentier's statistics. It is only exceptionally that the labor is protracted in the hemiplegic. La Motte (Observation CCXIX.)¹²⁸ gives, in his usual graphic manner, the history of a woman attacked with convulsive movements three days before labor; they were followed by loss of speech and almost entire loss of consciousness. When the labor began he recognized it by some contractions of the lips and slight movements of the pelvis during a pain. The woman was safely delivered, but there was complete paralysis of the right side; the patient slowly convalesced, so that at the end of six months she was able to go to the waters of Bourbon, where the cure was completed. The chief argument of La Motte that the patient had not true convulsions, though she had convulsive movements, was the fact that the child lived, whereas in true convulsions it would have been dead when so long a time passed before labor. He regarded the disease simply as apoplexy. Hemiplegia occurring during labor will most probably result from cerebral hemorrhage in connection with eclampsia, and it then presents an additional argument for prompt artificial delivery.

Paraplegia.—In paraplegic women the anesthesia of the abdominal wall

may be so complete that the subject is never conscious of the movements of the fetus and does not feel any pain in labor (Vinay). "In a patient of Bernhard's affected with progressive locomotor ataxia labor passed almost entirely without the patient's knowledge, suffering being felt only when the head was disengaged. In a case published by F. Benicke the patient had Pott's disease with compression of the cord. The accouchement took place at term without suffering, and so unexpected was it that the woman was first advised of the labor by the crying of the child." A patient of Bernays,¹²⁹ a victim of syphilis, was "totally paralyzed in her lower limbs and in all the muscles of her trunk which are supplied by nerves originating from the cord below the seventh cervical vertebra." The entire labor lasted only about thirty minutes, and its "peculiarity was, that in place of the usual interrupted labor-pains, there was but one continued contraction of the uterus, which resulted in the expulsion of a large, well-formed, healthy child." In Epley's patient¹³⁰ delivery was effected by forceps after labor had lasted a day. In the case reported by Litsekus,¹³¹ the woman suffering from progressive locomotor ataxia, the labor was very slow, lasting five days. Gamet, quoted by Vinay, states that the final period in labor may be long in overcoming the resistance of the perineum—not from the muscles which are paralyzed, but of the aponeurotic and fibrous parts.

Shock.—If shock occurs to a woman in labor, it is most frequently the result of a grave accident—for example, rupture of the uterus. Apart from the causal treatment of the condition, the practitioner should seek to obviate the tendency to death and to bring about reaction as soon as possible. Among the means he may employ are the external application of heat, alcoholic stimulants, ammonia, camphor, and the hypodermatic use of sulphuric ether and of strychnia.

Labor in Pneumonia.—By most obstetricians the occurrence of labor in a patient suffering with pneumonia is regarded as very unfavorable, and they therefore seek to avert any threatening of this event; but if parturition is inevitable, the latter is facilitated as much as possible. Great encroachment upon the chest-cavity by the uterus may be lessened by early rupture of the membranes, and the injury to the already overtaxed heart by labor-pains is avoided as soon as possible by artificial delivery.

Sudden Death in Labor: Delivery of the Child.—The chief causes of sudden death of the parturient are apoplexy, eclampsia, rupture of the uterus, of the heart, or of the aorta, exhaustion from protracted labor, uterine hemorrhage, pulmonary embolism, and, quite rarely, rupture of the spleen.

In sudden death in labor it is important that the child be delivered promptly. If the dilatation of the os is sufficient, the application of the forceps is indicated in vertex presentation; in that of the pelvis, the immediate bringing down of one or both feet, and extracting. According to Kaltenbach, not even one-tenth of the children delivered after the death of the mother live. He quotes Puech's statistics showing that in 453 operations one hundred and one children gave signs of life, but only forty-five survived.

Nevertheless, though the child be dead, its delivery should be made, "out of consideration for the relatives and friends of the woman and for the profession to which we belong, especially if the accoucheur has been in charge of the labor for some time and has already made attempts at delivery" (Spiegelberg). Some advise that when the mother is dying from pulmonary tuberculosis, from severe apoplexy, or other hopeless disease, delivery be made while she is yet alive, if consciousness and sensibility are lost.

If the mother die from slow asphyxia or from hemorrhage (either uterine or from rupture of the heart or of a large blood-vessel), the probability of saving the child is very slight, but if her death be from a sudden injury, from embolism, or from apoplexy, the chance of the child's living is greatly improved. It is usually held that if more than ten minutes intervene between the death of the mother and the extraction of the child, its living is doubtful; yet there are a few cases in which this period was considerably passed and the child was extracted alive.

As proving that in some cases a much longer period than ten or fifteen minutes may intervene between the death of the mother and the removal of a living child, the following facts are of value: ¹³² During the Commune of Paris, Tarnier one night at the Maternity was called to an inmate who, while lying in bed near the end of pregnancy, had been killed by a ball which fractured the base of the skull and entered the brain. He removed the child by the Cesarean operation, and it lived for several days. He states that the delivery may have taken place three-quarters of an hour, or even an hour, after the death of the mother. In another case a pregnant woman fell to the pavement from a window a distance of more than 30 feet, instant death resulting; thirty minutes at least after the death of the mother an infant was removed, which after some difficulty was resuscitated, and which lived for thirteen years. Tarnier also quotes the case, recorded by Hubert, of a successful Cesarean operation two hours after the mother's death: the woman, who was eight months pregnant, was instantly killed by a locomotive while crossing a railroad track.

In case the os be not sufficiently dilated for immediate delivery, Depaul stated that he could not too much insist, with almost all those who have studied this question, upon the advantages offered by extraction of the infant *per vias naturales*. One need not fear multiple incisions of the cervix by a bistoury; there can thus be obtained in a few seconds dilatation sufficient to make version or to apply the forceps. Thévenot ¹³³ states that the advice to deliver the child, in case the mother dies in advanced pregnancy, by the natural passage was first given in 1665 by Schenk. He quotes Baudelocque, Gardien, and Velpeau as having approved of this method. One advantage of it is that there need be no delay in case the evidence of the mother's death is not conclusive, and such delay in the Cesarean operation may be fatal to the child. It should be remembered that in several cases—not, however, occurring in recent years—the operator was startled by finding his subject only apparently dead. In case the Cesarean operation is selected, the same precautions are to be employed as if operating upon the living subject.

Aveling¹³⁴ collected 44 cases in which spontaneous expulsion of the child occurred after the death of the mother. The force concerned in such expulsion is usually the gases arising from decomposition accumulated in the abdominal cavity, causing pressure upon the uterus, or such gases in the uterus itself. It has, however, been claimed that in some cases expulsion of the fetus was caused by contractility of the uterus continuing after the death of the mother, while the resistance of the pelvic floor was lessened. Post-mortem inversion of the uterus may occur from gases resulting from decomposition in the intestines, the organ protruding from the vulva. Kaltenbach mentions a case in which a woman died from hemorrhage, the cause charged being the midwife's pulling upon the cord. Four weeks after death the body was exhumed and the inverted uterus was found in front of the vulva. Kaltenbach explained the inversion as post-mortem, and the midwife was acquitted.

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IV. THE PUERPERIUM.

I. PHYSIOLOGY OF THE PUERPERIUM.

The puerperium is the period of convalescence from child-birth. It begins with the close of the third stage of labor, and ends with the regressive changes which take place in the uterus and other genital organs after parturition. This process usually occupies six weeks; in exceptional cases it is not complete until the eighth or tenth week.

The condition of the puerperal woman has been aptly compared to that of a wounded patient. While not sick, she is "eminently predisposed to disease." The exhaustion following labor, the wounds and contusions of the birth-canal, the presence of putrescible fluids in the passages, together with the resorption activity of the utero-vaginal tract, are conditions which border closely upon the pathological, and are an ever-present menace to the safety of the post-partum state. The exalted irritability of the nervous system, too, contributes to the unstable equilibrium which characterizes the childbed condition. The puerperal process, therefore, though a physiological one, demands the constant exercise of care and skill in its management to prevent the invasion of disease.

Post-partum Chill.—A sense of chilliness, or even a distinct rigor, is frequently experienced at the close of labor or during the third stage. It is of short duration, rarely exceeding ten minutes, and is not attended with rise of temperature. The probable cause of the chill is the lessened heat-production due to the abrupt cessation of muscular effort after the expulsion of the child, and the rapid loss of heat by evaporation from the lungs and skin. It has no pathological significance, and requires no treatment except warm coverings and possibly a hot drink.

The Pulse.—Soon after delivery the pulse-rate, which has been somewhat increased during labor, falls, as a rule, below the usual normal standard. This retardation of the pulse generally begins within from eight to forty-eight hours after labor, and in exceptional cases continues until the end of the second week. Usually it lasts for a period of not more than three or four days in primiparæ, somewhat longer after subsequent births. The duration of the reduced pulse-rate is generally prolonged in proportion as the reduction is more marked. The frequency most commonly observed is from fifty to seventy per minute; rarely a minimum of forty or less has been noted. This alteration in the pulse is not attended with a corresponding variation of temperature. The cause of this phenomenon is doubtless connected with the mental and physical rest which follows delivery, and the sudden diminution in the amount of labor put upon the heart in consequence of the interruption of the utero-placental circulation. For several days after childbirth the frequency of the pulse is variable under slight disturbing influences.

The Temperature.—At the close of labor the temperature ranges from one

to three degrees above the normal, according to the length and severity of the labor. Within twelve hours it falls again nearly or quite to the usual standard. In twenty strictly normal cases selected from the writer's hospital service the average temperature at the close of labor was 99.67° F., the maximum being 100.5° and the minimum 98.4° ; at the end of twelve hours the average temperature was 99.18° ; twenty-four hours after labor it was 98.65° , the maximum being 99.5° and the minimum 98° F.

For the first four or five days of the puerperium 99.5° F., and for the balance of the period 99° F., should be regarded as the physiological upper limit of thermometrical range. Transient elevations of temperature, however, may occur from comparatively unimportant causes, such as emotional excitement, digestive disturbances, or constipation. A slight rise is sometimes observed on the establishment of lactation if the breasts are much engorged and painful. This rise is most likely to occur in debilitated and weakly women and in those unable to nurse. A temperature persistently above the foregoing limits must be regarded as evidence of some complication.

Secretions and Excretions.—The general effect of labor upon both secretions and excretions is to increase the activity of these functions. The skin acts freely. If the body is kept warm, perspiration is usually profuse. Hyperemia of the skin and consequent exudation into the hair-follicles sometimes result in partial loss of hair.

There is a notable increase in the volume of urine during the first week. Its specific gravity is a little lower than usual, the amount of water eliminated being greater than during pregnancy, while the total excretion of urinary solids *per diem* remains nearly or quite unchanged. This superabundant secretion of urine is one of the causes of over-distention of the bladder to which the patient is exposed after labor (Fig. 411). Other contributing causes of retention in the first few days are the posture of the patient, the lessened intra-abdominal pressure, urethral spasm, and the dread of pain during micturition owing to the bruised and fissured condition of the vesical neck, the urethra, and the vulva.

Glycosuria is observed in a considerable proportion of instances for a short time after as well as before labor. This is due to resorption of lactose, and the proportion of sugar in the urine fluctuates with the fulness of the breasts. It disappears as soon as the balance is established between secretion and consumption. Peptonuria exists for several days, peptone being a product of uterine involution.

Loss of Weight.—It is stated that during the first puerperal week there is a loss of weight, variously estimated by different observers at from one-twelfth to one-eighth the body-weight at the close of labor. This loss is attributed to the increased activity of the secretions and excretions and the small amount of food ingested during this period, together with the retrograde changes which normally take place in the pelvic organs. Under the present practice of allowing the patient a moderately full diet after labor the loss is generally confined to the first few days post-partum, and is soon made good.

Uterine Contractions.—Rhythmical uterine contractions, similar to those of labor, continue for a variable length of time after the delivery of the placenta.

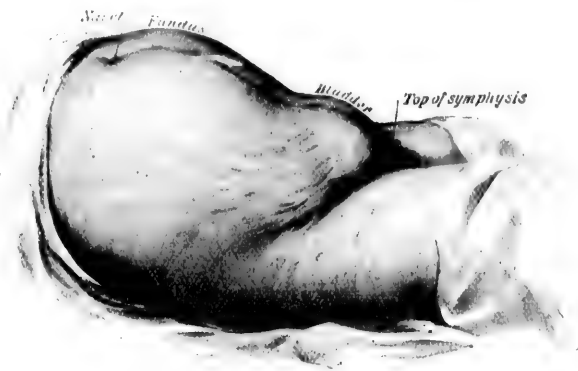


FIG. 411.—Extreme over-distention of the bladder during labor (from a sketch by R. L. Dickinson, M. D.).

The contractions of the uterus tend to exclude blood-clots from its cavity, to establish complete retraction, and thus to accomplish the permanent ligation of its vessels: by diminishing the blood-supply they promote in the uterus the retrograde changes which normally take place in the puerperal period. In primiparæ they are seldom painful. In multiparæ, in whom there is greater relaxation of the uterus and greater tendency to the retention of clots, they are more intense and are frequently accompanied with pain. After-pains in exceptional cases may continue for two or three days. Usually they cease after a few hours. They are intensified when the child nurses by the reflex influence of the mammary irritation. Even in women who have borne children they are, to a great extent, prevented by the use of measures to secure full and persistent retraction of the uterus immediately after the expulsion of the placenta.

Sometimes uterine contractions of a painful character occur, without the retention of clots, from purely neurotic causes. Pains of unusual severity, unduly prolonged and accompanied with great sensitiveness to pressure, may suggest the possible presence of beginning peritonitis.

The Digestive Organs.—Usually the appetite is diminished for the first few days after labor and the digestive powers are enfeebled. Owing to the rapid elimination of fluids by the skin and the kidneys, thirst is increased. The bowels act sluggishly in consequence of the small quantity of food ingested, the increased secretory activity of the skin, the diminished peristalsis, the lessened tonicity of the abdominal muscles, and the complete rest in bed.

GENITAL ORGANS.—Condition of the Parturient Tract.—By palpation over the lower portion of the abdomen at the close of labor the uterus may be felt as a hard, irregularly rounded mass reaching about halfway from the pubic bones to the umbilicus. Owing to the relaxation of the abdominal

walls, the fundus may be grasped in the hand, and even the round ligaments and ovaries can generally be mapped out. Within a few hours the uterus will be found somewhat relaxed, with the fundus at the level of the navel or a little above it. Usually it is slightly anteflexed, and its position is one of partial dextroversion and dextrotorsion. It is somewhat larger in multiparæ than after the first confinement. The placental area is somewhat elevated; its surface is uneven, and is studded with thrombi lying in the mouths of the utero-placental vessels. The outer layer of the decidua and fragments of the inner layer remain for a time, to be gradually cast off with the lochial discharge. A layer of blood or bloody mucus covers the entire wall of the uterine cavity. The cervix remains soft and relaxed for several hours after labor, having an almost gelatinous consistence. Its length is $2\frac{3}{4}$ inches or little more. The os internum presents the feel of a resisting ring, and in the intervals between uterine contractions it is sufficiently open to admit two or three fingers.

The lower border of the cervix is always bruised and fissured, sometimes deeply torn. After twelve hours the neck of the uterus begins to regain its former shape. Even in the absence of notable lacerations the vagina and vulva are swollen, abraded, fissured, bruised, and sensitive to the touch. For two or three days there is frequently more or less edematous swelling of the labia. The hymen in primiparæ is torn at numerous points, its fragments skirting the vaginal orifice as small projections which ultimately form the *carunculæ myrtiformes*. The vulvar orifice gapes more or less according to the extent to which the soft structures have been overstretched or torn during the birth (Pls. 42, 43).

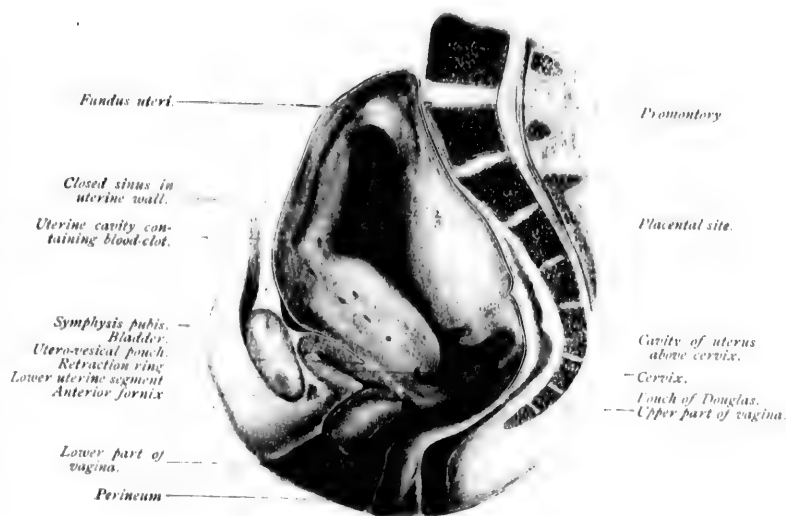
— *Involution*.—In all the pelvic organs which have undergone hypertrophy during pregnancy a corresponding atrophy of the tissue-elements takes place during the puerperium. This process affects the ovaries, the Fallopian tubes, the uterine ligaments, the vagina, the external genitals, and especially the uterus. Except in primiparæ the pelvic structures are in normal conditions fully restored to the pre-gravid state. After the first labor the return to the virgin condition is never complete, particularly in the uterus and the vagina. The enlargement of these organs remains in some degree permanent.

The Uterus.—The uterus, as the principal seat of the building-up process during gestation, undergoes the most important retrograde changes in course of the lying-in period. The rate of uterine involution is shown in the following tables. According to Heschl, the weight of the uterus is—

At the close of labor,	770 to 805 grams.
“ end of the first week,	665 to 735 “
“ “ “ second “	350 to 385 “
“ “ two months,	45 to 75 “

According to Kaltenbach, the organ immediately after labor weighs about 1000 grams (2 pounds).

The uterus measures at the close of labor from 19 to 21 centimeters ($7\frac{3}{8}$ to $8\frac{2}{5}$ inches) in length, and 11 centimeters ($4\frac{3}{8}$ inches) in width at the level of



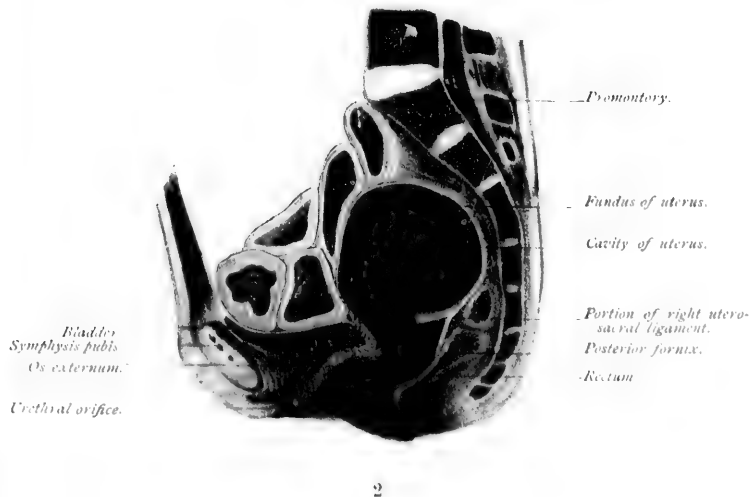
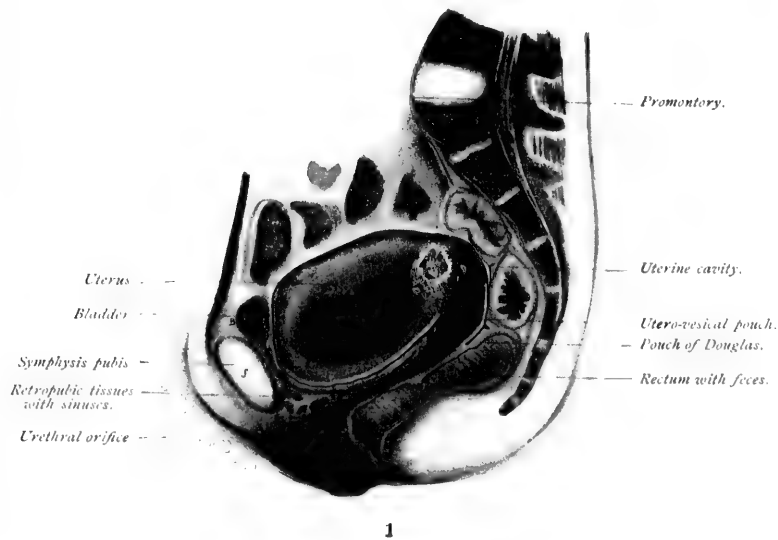
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1. Vertical mesial section of uterus at close of labor, five minutes after delivery (after Webster). 2. Vertical mesial section of uterus, second day of puerperium (after Webster).





1. Vertical mesial section of uterus, sixth day of puerperium (after Webster). 2. Vertical mesial section of retroverted uterus, fifteenth day of puerperium (after Webster)



the Fallopian tubes, and its upper segment is from 3 to 4 centimeters ($1\frac{1}{8}$ to $1\frac{3}{8}$ inches) in thickness. The cavity is from 15 to 18 centimeters (6 to $7\frac{1}{4}$ inches) in depth. The following sound measurements are from Hansen:

Tenth day,	8. to 13.5 cm.	Sixth week,	6.2 to 9.1 cm.
Fifteenth day,	8.3 to 11.5 "	Seventh "	6. to 8.5 "
Third week,	7.5 to 10.5 "	Eighth "	5.6 to 8.5 "
Fourth "	7. to 9.3 "	Tenth "	5.4 to 7.5 "
Fifth "	6.5 to 9. "		

The fundus uteri lies about midway between the umbilicus and the pubic bones at the close of labor. Within a few hours it is just above the umbilicus, and is at the level of the pubic bones by the tenth day. The elevation of the fundus, however, varies with the fulness of the bladder and the rectum. The uterus is pushed up bodily when these viscera are distended.

Involution is retarded in non-nursing women, after twin births, much hemorrhage, retention of secundines, sepsis of the endometrium, or getting up too soon.

Uterine Muscularis.—Various theories have obtained with reference to the nature of the changes in the uterine muscular structure during involution, some authorities holding that a part, others that all, the muscle-fibres are destroyed by a process of acute fatty degeneration, and that there is partial or total re-formation of muscle-elements. Snger has shown by a large number of observations that the regressive process is one of atrophy, by which the muscle-fibres are reduced to their primitive dimensions. The muscle-fibres are not destroyed by complete fatty degeneration: they undergo a true involution until they have reached their earlier size and form. Similar conclusions have been reached by Dietrich. The nutritive activity in the uterus is greatly diminished by the lessened blood-supply consequent upon uterine retraction after labor, and atrophy ensues, fat-globules appearing only in the interior of the muscle-cells and never externally to the fibrillae. The fat-globules "do not enter as such into the circulation, but are oxidized in the place where they occur. The intermuscular connective tissue experiences a similar involution in its cellular and fibrillar elements."

Blood-vessels of the Uterus.—Thrombosis takes place in some of the sinuses at the placental site during the ninth month of pregnancy. The remaining ones are promptly closed by compression and by the formation of coagula after labor. A portion of the blood-vessels become atrophied as the result of pressure. Fatty degeneration takes place in the media. The larger arteries are partially or wholly obliterated by connective-tissue proliferation of the intima. In women who have borne children the coats of the uterine arteries remain permanently thickened and the arteries larger than in the nulliparous uterus. The walls of the venous sinuses are thickened and convoluted for several weeks after delivery; the location of the placental site is discernible many months after labor. The mucous membrane is studded with pigmentary deposits, an unfailing sign of recent childbirth.

Reconstruction of the Uterine Mucosa.—The deep glandular layer of the decidua, together with fragments of the superficial layer, remains attached to the uterus after the expulsion of the placenta. From the glandular layer the regeneration of the mucous membrane takes place. All the remaining decidual structure not concerned in the development of the new mucous membrane suffers fatty degeneration and is gradually thrown off in the lochial discharge. The glands are crowded close together by the uterine retraction. About the mouths of the glands islands of new epithelium are formed, developed from the gland fundi. These coalesce until the surface of the uterine wall, including, last of all, the placental area, is covered. By the end of the fifth week, as a rule, the new mucous membrane is complete.

Lochia.—The genital discharges of the puerperium are termed the *lochia*. They have their origin in the cavity of the uterus, and continue during the greater part of the period of involution. They consist at first of blood with clots and decidual shreds, and usually are of a distinctly bloody character for three or four days—*lochia rubra* or *cruenta*. During the next two or three days they are pale in color, are thinner, and consist mainly of serum—*lochia serosa*; they contain blood-corpuscles, epithelial cells, and shreds of decidua. Finally, after about seven days, the discharges assume a grayish or a yellowish color and are of a creamy consistency—*lochia alba*. The microscopic elements are chiefly leucocytes, new epithelial cells, connective-tissue cells, fat-globules, and cholesterin crystals. The reaction of the lochia is neutral or alkaline during the first week; later it is acid. The discharge gradually diminishes in quantity, ceasing altogether by the end of from two to six weeks. The average amount for the first eight days is about three and a quarter pounds; the quantity, however, varies. It is greater in multiparæ than after first labors; it is more abundant and lasts longer in non-nursing women and in those who menstruate profusely. There is frequently complete or partial suppression of the flow on the establishment of the milk-secretion. The lochia rubra persists longer in retroversion of the uterus and after getting up too soon. Normally, the lochial discharge has only a faint odor and is never fetid.

Even in normal conditions micro-organisms are found in the genital discharges after the first two or three days. Their abundance varies in different cases and increases with the progress of the flow. The principal varieties are single cocci, staphylococci, and bacilli. Their occurrence in the lochia is explained partly by the presence of bacteria primarily in the vagina, partly by entrance from without. The uterine lochia, as a rule, are free from bacteria in normal cases.

Lactation.—Important changes in the mammary glands take place during pregnancy in preparation for lactation. They become enlarged by growth of the acini, by interlobular deposit of fat, and by swelling and proliferation of connective tissue. In the later months of gestation a milky serum may be expressed from the nipples. The mammary secretion of the first days of the puerperium is similar to that of the latter part of pregnancy, and is termed *colostrum*. It is a viscid fluid of a faint lemon-yellow color, and is richer in

fat, sugar, and the inorganic salts than the fully-developed milk-secretion. At this early period, before the function of the gland-cells is established, it is little more than a transudation from the blood. Accordingly, there is a preponderance of albumin and a deficiency of casein. Its chief microscopic elements are fat-globules, mucous corpuscles, pavement epithelium, occasional milk-corpuscles, and large round granular epithelial cells, known as *colostrum-corpuscles*. The latter do not wholly disappear for several days after the true milk-secretion is established. The laxative property of colostrum is attributed by Winckel and others to the abundance of phosphate of calcium, chlorids of sodium, potassium, and magnesium in its composition. The large proportion of fat and of milk-sugar doubtless contributes to the cathartic action. De Sinéty ascribes the laxative effect of colostrum to its indigestibility.

The true milk-secretion begins usually on the second day in multiparæ, on the third day in primiparæ. The mammary glands become swollen and more or less painful, the veins are prominent over the breasts, and the axillary glands are frequently enlarged and sensitive. Some general disturbance is experienced in the presence of great tension and pain in the breasts, particularly in nervous women. Thirst, loss of appetite, malaise, and, in exceptional cases, a slight elevation of temperature, may be observed on the development of the milk-secretion.

True milk fever, it is generally conceded, does not exist. That painful engorgement of the breasts, however, may give rise to transient fever in the condition of unstable equilibrium which characterizes the puerperal woman cannot be doubted. Yet it must not be forgotten that a rise of temperature at this time may be, and most frequently is, due to septic absorption from the genital wounds.

Human milk contains on an average 1.5 per cent. of albuminoids, 4 per cent. of fat, 7 per cent. of sugar, 1.4 per cent. of inorganic salts, and 86 to 87 per cent. of water. These proportions, however, are subject to considerable fluctuation. They are affected by the health and habits of the woman, and even by emotional disturbances, and they vary, too, with the period of lactation. There is an increase in casein until the second month; thereafter it diminishes until the ninth month. Similar variations occur in the percentage of fat. The sugar increases after the first month. Authorities, however, are not agreed on the nature and the extent of the changes which take place in the composition of breast-milk from month to month.

The composition of the lacteal secretion departs somewhat from the usual normal standard on the return of the menstruation. These changes are generally of short duration, lasting but a few days after the menstrual period. In exceptional cases they remain to a greater or lesser extent permanent. Frequently no harm comes to the mother or the child from the continuance of nursing even when the menstrual function is resumed in the early weeks of lactation; in exceptional instances it may be necessary in the interests of the child, and possibly of the mother, to discontinue nursing.

The liquid portion of milk is derived, with some modification, from the

blood; the fat, sugar, and casein are products of the metabolic changes in the protoplasm of the secretory cells of the mammary glands. The fat or butter is held in suspension in the liquid portion in minute globules of variable size, forming a fine emulsion.

The average normal period of lactation is about one year. In most nursing women, however, the milk begins to fall off in both quality and quantity after the seventh or eighth month. Both the abundance and the duration of the secretion vary greatly in different cases according to the health and vigor of the woman. In normal conditions the quantity increases during at least the first six months proportionately to the needs of the child's nutrition. In non-nursing women the secretion continues for a few days, then rapidly declines, and soon ceases altogether, the parenchyma of the gland undergoing involution.

II. DIAGNOSIS OF THE PUERPERAL STATE.

The puerperal condition can usually be recognized with little difficulty within the first one or two weeks; later the diagnosis is not so readily established. The evidence of recent delivery is to be sought principally in the condition of the breasts, the abdomen, and the genital tract. After the first two days the breasts are enlarged and tense. The mammary glands are firm and nodular and milk is freely secreted.

The abdominal walls are lax, and the skin can be taken up in folds over the underlying muscles; *striae gravidarum* and the pigmentary changes are evidence that advanced pregnancy has at some time existed, other causes of abdominal enlargement sufficient to explain the presence of *striae* being excluded. The external genitals are gaping, swollen, bruised, and fissured for several days after childbirth, and for at least two weeks they present the marks of recent injury of greater or lesser degree. The vagina is enlarged and relaxed; the rugæ are effaced and the introitus stretched and torn. The uterus is enlarged, the cervix is notched or deeply fissured by recent tears, and its canal admits one or more fingers. The size of the uterus in normal conditions diminishes daily. The lochial discharges are found flowing from the cervix, and the placental site presents to the examining finger the nodular surface and fresh thrombi characteristic of recent delivery. The lochial discharges are distinguished from hemorrhage of non-puerperal origin by their microscopic constituents. When the importance of the question justifies it, conclusive evidence may sometimes be obtained by curetting the uterine cavity. The presence of decidual shreds or chorial villousities in the scrapings affords indubitable proof of recent pregnancy.

The length of time that has elapsed since confinement may during the first two weeks be estimated approximately by the condition of the breasts, the size of the uterus, and the character of the lochia. For the first two or three days the mammary secretion is colostrum; for several days subsequently the glands are swollen and hard and milk is abundantly secreted. The fundus uteri is

just above the umbilicus on the day following delivery, and it gradually sinks to the symphysis by the tenth. The changes in the lochia indicate roughly the progress of the puerperal period. The vulvar wounds are in a stage of repair proportionate to the number of days that have passed since the birth.

III. MANAGEMENT OF THE PUERPERIUM.

Posture.—During the first few hours after labor the best position for the patient is the dorsal decubitus. If she turns upon the side, owing to the lax condition of the abdominal parietes the uterus falls forward, and air may be drawn into the passages, exposing the patient to the possible danger of air-embolism. After the uterus has become permanently retracted and the vessels at the placental site are firmly closed by thrombi, the posture of the patient may be left to her own choice.

Rest.—A sound sleep of several hours after delivery is a favorable prognostic. It not only speaks well for the condition of the patient, but is a potent restorer. Care should be taken, therefore, to procure rest and sleep as soon as possible after the necessary attentions to mother and child have been completed. The room should be quiet, and the light be subdued by drawing the curtains. The use of hypnotic drugs is, if possible, to be avoided. It is especially important that the child be not permitted to disturb the mother's rest. It ought not to sleep in the same bed with the mother, and if it cries should be removed to another room.

Physician's Visits.—It is generally desirable that the first visit be made within twelve hours after confinement. This, however, is not always necessary when a competent graduate nurse is in charge. It is the duty of the physician to make a systematic examination of both mother and child at each visit. The principal points to be observed during the first days after delivery are—the general appearance of the woman, whether she has rested sufficiently; what and how much nourishment she has taken; the amount and character of the flow; whether the bladder has been emptied, and the quantity of urine passed; if the bowels move daily after the first twenty-four hours; the presence or absence of after-pains, and how severe they are. The pulse and temperature are to be noted. The binder should be loosened at each visit, and the uterus examined through the abdominal walls for the rate of involution as indicated by the height and width of the fundus; the degree of tenderness over the uterus and broad ligaments should be noted. It is especially important at the first visits to examine the suprapubic region by palpation to learn whether the bladder is distended. The urinary secretion is, as a rule, greatly increased during the first few hours after delivery. Injurious distention of the bladder frequently results. The assurance that the patient has passed water freely is not to be taken as proof that there is no retention. When overfilled the bladder may easily be made out as a fluid tumor between the uterus and the abdominal walls. Pressure with the hand over this region, too, will cause a desire to urinate. Marked fulness of the bladder frequently presents a visible

tumor above the pubes (Fig. 411). The condition of the breasts and nipples and the amount of milk secreted should be watched, especially during the first week.

Daily inquiry should be made with reference to the child—whether it nurses properly and shows signs of thriving; the condition of the eyes, mouth, skin, the stump of the navel cord, or the umbilical wound should be learned, and whether the bladder and bowels are properly evacuated. It is well for the first few days to know the rectal temperature. The nurse, if she be capable, will keep a systematic record of the foregoing and other facts for the doctor's inspection at his daily visits. Her observations ought to be taken at stated hours two or three times during the day, and recorded on suitable blanks. This is particularly important during the first week. After that time if all is normal a simpler record will suffice.

After-pains, if severe enough to deprive the patient of sleep or to be exhausting, must be relieved. A grain or two of opium or an equivalent dose of morphin may be given, and be repeated once or twice subsequently if required. Since many women do not bear opium well, and as it is especially liable to injure the appetite and digestion, the object may usually be better accomplished by the use of chloral in doses of 20 or 30 grains. It may be given in water or in milk, by the mouth or by the rectum. The coal-tar analgesics are effective, but their repeated use is open to the objection that they lessen the strength of the uterine contractions and consequently retard involution. Little harm will be done when but one or two doses are required. Of these drugs, phenacetin, in doses of 5 grains, is to be preferred to acetanilid or to antipyrin, as it has a less depressant effect.

Asepsis.—Most important is a rigid cleanliness of the external genitals of the patient, her linen, and the bed-linen. The vulvar dressings should be changed every three to six hours during the first two or three days, and at all times as often as much soiled. Each time the dressing is renewed the external genitals and their immediate surroundings are to be carefully cleansed with soap and water, and finally washed with an antiseptic solution. A convenient method of cleansing the vulva is by irrigation with a fountain syringe, the stream being projected against the parts to be cleaned and its action assisted by gentle friction with aseptic fingers. A bed-pan in position beneath the buttocks receives the washings.

If any fetor is perceptible, it must be assumed, as a rule, that the toilet of the patient has not been properly cared for. If the passages have not been infected during the labor, external measures will be sufficient to keep the discharges sweet. Douching and all other interference within the passages are to be strictly avoided in normal cases. If the discharges become fetid notwithstanding proper external precautions, an antiseptic vaginal douche should be given two or three times daily or often enough to suppress all putrid odor. The approaches must first be rendered aseptic: the douche-tube, sterilized by boiling, is introduced for only 1 or 2 inches, with care to avoid abrading the mucous surfaces. Mercurials should not be used for the purpose, owing

to the danger of mercurial intoxication. A 15-volume solution of hydrogen dioxid, in full strength or diluted with three or four volumes of water, or Labarraque's solution in water (1 : 9), is suitable. It is unnecessary to say that other soiled portions of the body should be cleansed as often as soiled, and no blood-stained linen should be permitted to remain about the patient or the bed.

The lying-in woman perspires actively, hence her skin ought to be frequently cleansed by sponging with tepid water or with water and alcohol. This bath should be followed by gentle friction with a towel until a warm glow is produced. Cleanliness of the bed is promoted by the use of a draw-sheet, which consists of a common bed-sheet folded to four thicknesses. It is placed upon the bed beneath the patient's hips, and is changed as often as soiled.

Ventilation.—The atmosphere of the lying-in room must as nearly as possible be pure. Air should be admitted as freely by open windows as is consistent with a proper temperature of the apartment. As the air is constantly vitiated, so the ventilation, to be effective, must be continuous. Light is essential to the healthfulness and cheerfulness of the lying-in chamber. The practice of darkening the room, except when temporarily necessary to promote sleep, is irrational and has justly become obsolete. Even the full sunlight may be admitted, provided the child's eyes are properly protected. For the first few weeks the eyes of the new-born infant should be shielded from strong light from whatever source.

Diet.—The diet for the first twenty-four hours is to be restricted, as a rule, to liquids. In most cases even liquid food is to be withheld until the patient has had a few hours' rest. After the use of anesthetics no nourishment will be borne until she has recovered from the effect of the anesthetic. Exceptionally, when the labor has been an easy one without anesthesia, a little warm liquid nourishment, such as clear soup, bouillon, gruel, or cocoa and milk, may be allowed, if the patient requests it, directly after the close of labor. On the second day soft-boiled eggs, boiled custards, panadas, and similar easily-digested semi-solid foods are suitable. From this time on a moderately full diet is generally to be recommended. The dietary, however, must be varied to suit the needs of the individual case. As liberal a diet as the patient can digest is essential to the normal progress of convalescence and to the proper quantity and quality of the milk-secretion in nursing women.

Retention of Urine.—The enfeebled control over the bladder in the first hours after delivery frequently leads to retention of urine. This is especially liable to occur from the added effect of reflex disturbance when the perineum has been sutured. Owing to the copious secretion of urine, which is common at this time, painful and injurious distention of the bladder often results. Not only may serious injury thus be done to the bladder, but uterine hemorrhage after delivery is liable also to occur from over-distention of this viscus. The patient must be warned, therefore, of the importance of passing her urine within six or eight hours following the close of labor and at similar intervals thereafter. The difficulty of urination depends partly upon the recumbent position, and it may frequently be overcome, therefore, by allowing

the patient to assume a sitting or half-sitting posture during attempts at micturition. The sound of running water, warm fomentations over the meatus urethrae, and moderate pressure applied with the hand over the suprapubic region are useful aids, and are frequently effective even in the reclining position. The catheter should be withheld as a last resort, owing to the danger of setting up a more or less intense catarrh of the vesical neck from infectious material carried on the instrument. The mucosa of the lower portion of the bladder is liable to be bruised and fissured during labor, and its resisting power thereby impaired. In rare cases the ureters and the pelvis of the kidneys may be invaded by the septic process which frequently takes its origin from catheterization.

Use of the Catheter.—When catheterization is unavoidable, every precaution must be used to prevent infection of the bladder. The soft-rubber instrument, which is least liable to do mechanical violence to the vesical mucous membrane, is generally the most suitable catheter for use by the nurse. The Kelly or other glass catheter, which consists of a short glass tube with a foot or two of rubber tubing attached, has the advantage that it presents a perfectly smooth polished surface, and causes, therefore, a minimum amount of urethral irritation. Boiling in water for ten minutes immediately before using the instrument renders it aseptic. It is perhaps needless to say that after boiling the catheter is to be handled only with hands that have been carefully sterilized.

The instrument must never be passed blindly by the sense of touch alone. With the patient in the dorsal position and the thighs separated, the labia should be held well apart, either by the patient herself or by an assistant, so as to expose fully the meatus urethrae to view until the catheter is introduced. The vestibule and labia are then to be cleansed with soap and water and washed with a suitable antiseptic. The catheter, well lubricated with vaselin previously sterilized by heat, is then passed—only far enough barely to enter the bladder—until the urine begins to flow. Care should be taken on withdrawing the instrument that no urine be permitted to trickle into the vagina or over the vulvar wounds. If the parts accidentally become soiled, they should be cleansed by pressing them with a clean damp cloth. The catheter is to be washed carefully with soap and water and rinsed with clear water after using. The bladder should be emptied at the same intervals as in voluntary urination.

Evacuation of the Bowels.—It is a long-established custom to open the bowels on the third day. There are good reasons for adopting the practice, now so generally followed after abdominal section, of evacuating the bowels soon after labor, not later than thirty-six hours. The most suitable measure is a mild saline laxative. An eligible saline for the purpose is the solution of citrate of magnesium (liquor magnesiæ citratis). The action of the bowels may, if necessary, be assisted by a rectal injection of warm water or of sweet oil. Useful stimulating enemata, if required, are salt water, soap and water, a drachm or two of undiluted glycerin, or one or two ounces of a saturated

solution of Epsom salts. The bowels should be opened daily after the first day.

Lactation.—In the interests of both herself and her infant the mother ought, as a rule, to nurse her own child. In certain conditions, however, this may be inadvisable or even impossible. Syphilis contracted late in pregnancy and tuberculosis are contra-indications to maternal nursing, owing to the danger of infecting the child. Rarely, suckling may be impracticable by reason of inversion of the nipples, or may have to be discontinued in consequence of excoriation and persistent sensitiveness of these organs. Sometimes the mother's milk is deficient in quality or in quantity. In marked general debility from whatever cause nursing would be injurious to both mother and child.

The early application of the child to the breast promotes the uterine contractions: it is particularly advisable when the uterus remains relaxed after labor. As a rule, the child is put to the breast only after the mother has rested, after six or eight hours. It should be nursed once in four hours during the first few days until the mammary function is established. Usually the child will thus have learned to nurse before the onset of the true milk-secretion, and the danger of painful engorgement of the breasts will be diminished. Regularity in nursing is as essential to the interests of the mother as to those of the child. The nipple is injured by prolonged and frequent maceration. The milk becomes concentrated by over-frequent suckling, thin and dilute when the intervals are too prolonged. For this reason the child should not be permitted to sleep in the same bed with its mother: it should lie in a crib by itself. The healthy condition of the nipples will be promoted by carefully cleansing and drying them after the child has nursed. A saturated solution of boric acid is a simple and effective lotion for the purpose. If they are disposed to crack, it is useful to anoint the nipples with fresh cacao-butter after cleansing. During the first few days of lactation the breasts frequently become painfully swollen. Painful induration of the glands in the absence of inflammation is relieved by gentle massage, stroking the breasts outward from the base toward the nipple. This manipulation is best practised immediately before putting the child to the breast. Distention from over-free secretion is relieved by saline cathartics, by abstention from liquids, and by the use of a compression breast-bandage. An easily improvised binder is the Murphy binder. It is made of a straight piece of muslin, with a shallow notch cut in one edge for the neck and a deep notch for each arm (Fig. 412). The bandage is closely applied over the breasts, the ends being pinned in front (Pl. 27, Fig. 2).

Not infrequently, especially in debilitated women, the supply of milk is insufficient. The most reliable evidence of defective lactation is afforded by the signs of inanition in the child. If the infant ceases to gain in weight or if the weekly gain falls short of the normal, in the absence of disease it is to be assumed that the quantity or the quality of the mother's milk is at fault. In many cases it is possible to do something to improve the character and to increase the quantity of the breast-milk by attention to hygienic measures.

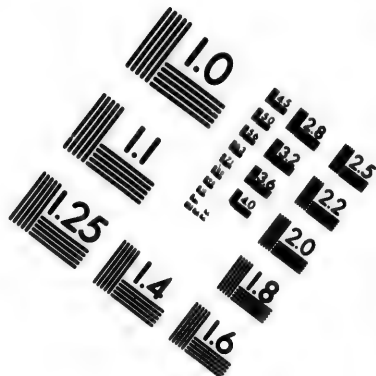
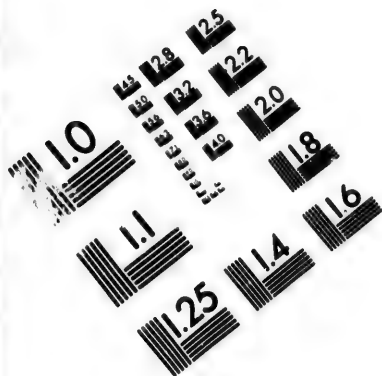
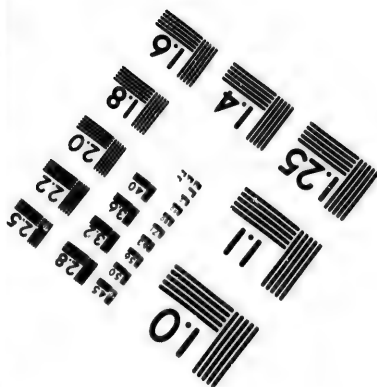
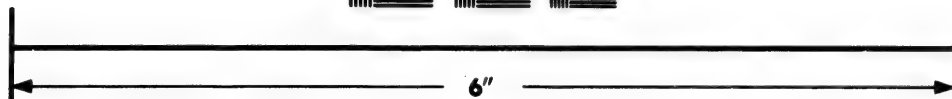
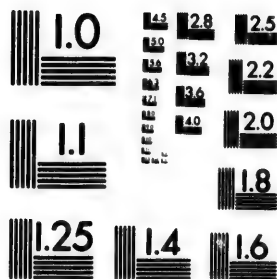


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The best galactagogues are tonics, a generous diet, including the use of milk, and attention to the habits and hygienic surroundings of the mother. Precau-

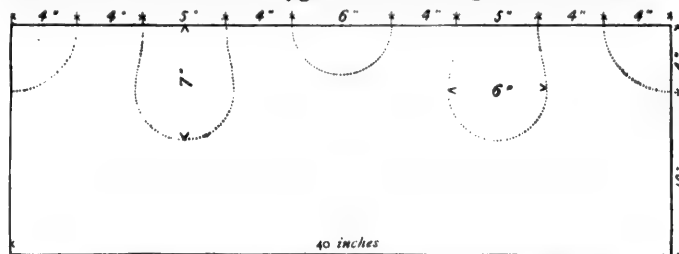


FIG. 412.—Modified Murphy breast-binder (cut on the dotted lines).

tions must be taken, however, against over-feeding and consequent derangement of the digestive organs. The daily application of a mild faradic current through the breasts, it is claimed, acts to stimulate the mammary functions. In the writer's experience the sulphate of strychnin in doses of from $\frac{1}{40}$ to $\frac{1}{30}$ of a grain, three times daily, has apparently done good service, probably more by its general tonic effect than by any specific influence. When, owing to the death of the child or for other reasons, it becomes necessary to dry up the milk, a purely expectant treatment usually answers. The patient, however, generally suffers more or less pain in the breasts for two or three days. Her comfort is promoted and the disappearance of lactation is more rapid with the use of the compression binder. Daily applications of the oleate of atropia are of great value for the relief of pain and for their specific effect in drying up the secretions. Restriction of liquids and the use of a saline cathartic also help. The iodid of potassium in 15-grain doses repeated two or three times daily exercises a remarkable influence in diminishing the flow of milk.

Tardy Involution.—When in the daily examination of the uterus it is found that involution is not progressing normally, measures should be used to accelerate the process. Friction applied two or three times daily is useful for this purpose. The nurse lays the hand flat upon the abdomen over the uterus, and moves the abdominal walls in a circular direction over the anterior surface of the uterus, precisely as is done for stimulating uterine contractions in the third stage of labor. This procedure should be conducted gently, so as to give no pain, and it may be continued for ten minutes at each sitting. Faradism or galvanism is useful for hastening involution. A mild faradic current may be used ten or fifteen minutes daily, or a smooth galvanic current of ten to twenty milliamperes may be employed for the same length of time. One electrode is placed over the upper part of the sacrum and the other on the abdomen over the uterus. A hot vaginal douche once or twice daily is an agent of value for promoting involution. The temperature of the water should be about 115° F., and the quantity used not less than two or three gallons. Ergot in doses of a grain of the solid extract or its equivalent three times daily may be given with benefit. Sometimes the cause of the retarded involution is a septic condition of the endometrium. The remedy in such

cases is a thorough curetting of the uterine cavity. An iodoform-gauze drain may be left in the uterus after curetting. The gauze should be removed in three or four days, sooner in case of fetid lochial discharges.

Special Directions.—Few women, particularly of the better classes, approach labor in the full vigor of health. The pressure-effects of the later weeks of pregnancy, the impaired nutrition, the loss of exercise, and the mental anxiety which are common at this period, all conduce to enfeeble the physical powers. When to these conditions are added the exhausting effects of labor, it is not surprising that childbirth is frequently followed by more or less debility, even in the absence of complications. Restorative measures, therefore, usually constitute an important part of the management of convalescence. The necessity for plenty of sleep and a proper diet has already been alluded to. In addition to this the use of tonics is often of signal service. In anemia one of the proto-salts of iron may be given for several weeks. The Bland pill is a popular and valuable hematinic. The arsenate of iron is especially efficacious in the treatment of anemia in puerperal women. Attention should be paid to the condition of the digestive organs, and the amount and character of the patient's food should be regulated. If the appetite is poor, a bitter tonic may be prescribed. An eligible mixture for the purpose is the elixir of calisaya with strychnin; ʒij of the former and gr. $\frac{1}{16}$ of the latter may be given three times daily. A good general tonic is citrate of iron and quinin with strychnin or nux vomica. A drachm of the double citrate with a grain of strychnin may be prescribed in a four-ounce mixture, with directions to take a teaspoonful three times a day; or 2 grains of the citrate with one-third grain of extractum nucis vomice may be administered in pill form with the same frequency.

Special attention should be given to the condition of the pelvic organs during the post-partum month. For the first ten days the daily examination of the uterus by the abdominal touch will enable the physician to observe the progress of involution. After that time the position and size of the uterus cannot readily be determined by abdominal examination. It is generally advisable, even in private practice, to make a bimanual examination during the third or fourth week with special reference to the shape and position of the uterus. In hospitals it is the rule to explore the pelvic contents shortly before the patient's discharge. If the uterus be retroverted, it should be repositioned, and be held in place by a suitable pessary. Often persistent retroversion may thus be prevented. The pessary may be disused after two or three months. Undue persistence of the red flow or an abnormally open cervix is generally to be taken as evidence of endometritis. For the treatment of this condition applications within the uterus of tincture of iodine or iodized phenol (carbolic acid and tincture of iodine equal parts) at intervals of a few days are useful. Most effectual is a curettage with drainage of the uterine cavity with iodoform gauze. This procedure should be conducted with strict antiseptic precautions. The gauze is to be removed in from three to five days.

Regulation of the Lying-in.—The length of time which it is desirable that the woman should be kept at rest after labor will obviously vary with the rate of uterine involution and with the general progress of convalescence. During the first week she ought not to leave her bed. Ordinarily she may be allowed to rise partly or fully into a sitting posture during micturition. This often obviates the necessity for using the catheter in patients who have difficulty in passing water in the reclining posture. It also favors the expulsion of vaginal blood-clots, and after the first six or eight hours does not, as some writers have asserted, expose the patient to displacement of thrombi or to hemorrhage. Throughout the second week the patient ought to maintain for the most part the recumbent position, though she need not be confined to bed. She may for a part of the day be removed to a lounge or may lie upon the outside of the bed, and may sit erect when taking her meals. During the third week a large portion of each day may be spent in a chair. The patient, however, should not, as a rule, be allowed on her feet. In the fourth week she can have the liberty of the room, and at the end of the puerperal month, if all goes well, may be permitted to leave her room. It is advisable, however, that she should not fully resume her usual duties for two or three weeks.

CARE OF THE NEW-BORN INFANT.

Immediately after birth of the head the child's face should, when opportunity permits, be bathed with warm water, the eyes cleansed and carefully dried. This is done as a prophylactic against ophthalmia. As a still further preventive, within an hour after birth a drop of Credé's solution (a 2 per cent. solution of nitrate of silver) should be instilled into the conjunctival sacs of each eye. The latter precaution, when properly executed, is absolutely protective. No permanent injury is done to the delicate structures, and the serous oozing which frequently results subsides within a few days. Should it be excessive, it may be promptly controlled by a single application of a drop or two of a $\frac{1}{2}$ per cent. solution of the sulphate of atropin.

The ligation of the funis and the dressing of the stump have been already considered. Usually respiration is promptly established at birth, partly by the air-hunger developed by interruption of the utero-placental circulation, and partly by the reflex effect of the contact of cool air with the moist surfaces of the body. When the new-born infant does not breathe properly soon after birth, means should be employed to secure the full expansion of the lungs. Useful measures for this purpose are blowing forcibly upon the face, dashing a few drops of cold water upon the chest or the face, or gently slapping the buttocks with the hand or with the end of a wet towel. These efforts should be continued until the child cries lustily. When respiration is obstructed by mucus in the throat, the offending material may be removed by the finger wrapped with a soft rag. Still better for the purpose is a soft-rubber tube with a bulb attached. The tube is passed deeply in the pharynx and suction applied by means of the bulb. Two or three repetitions of this process will

usually serve to clear the throat of the obstructing mucus. Suspending the child by the feet facilitates drainage of liquids from the air-passages. The treatment of asphyxia does not fall within the scope of this section.

Care must be used to protect the child against injurious chilling. It must not be forgotten that an abrupt transition has taken place from a temperature of about 100° F. to one nearly or quite thirty degrees lower, and harm may be done by prolonged exposure. The child, therefore, is to be wrapped carefully in flannels, and as soon as the cord is cut it should be laid in a warm place until the necessary attentions to the mother are completed. The head while moist should be covered as well as the trunk and limbs. The stump of the navel cord ought to be inspected occasionally, to see that it does not bleed from loosening of the ligature as the stump shrinks. After the principal duties to the mother have been disposed of, the obstetrician examines the child for possible faults of development and for injuries during birth. The weight and length of the new-born child and the principal measurements of the head are matters of scientific interest: the weight especially ought to be noted for comparison with the results of subsequent weighings as a means of determining whether nutrition is going on properly. A small and accurate spring balance, therefore, may well be a part of the obstetrician's outfit. A Schultze pelvimeter or other simple calipers is a suitable instrument for measuring the head.

It is well to direct the nurse to administer to the child, within a few hours after birth, a rectal injection of a tablespoonful of warm water for the purpose of determining the presence or the absence of atresia ani. If the rectum be impervious, the water returns as fast as injected. Should no meconium be passed within a few hours, the physician must explore the lower bowel for possible occlusion. The nurse is also to observe whether the child urinates as evidence that the urethra is pervious. Failure to pass urine for several hours, however, need not excite alarm. The bladder is usually emptied in course of the birth, and but little urine is secreted until the child begins to nurse. Atresia of the urethra is much less frequently met with than that of the rectum; it is, in fact, extremely rare. Useful information may sometimes be afforded by taking the temperature per rectum. The notion that the new-born infant should be placed upon its right side to favor the closure of the foramen ovale has no foundation in fact. It may lie indifferently upon the back or upon either side, changing its position occasionally.

Bathing.—The first bath, if the child be robust, may be given soon after it is separated from its mother. In case of feeble children the full bath should be postponed for several days. In the latter, inunctions of sweet oil, vaselin, or fresh cacao-butter are to be substituted for the general bathing. As a preliminary to the first cleansing the skin is to be well rubbed with sweet oil or similar fatty material to facilitate the subsequent removal of the vernix caseosa. The temperature of the water should be 98° F. The regulation of the temperature must not be trusted to the hand. A bath-thermometer should be used. While the temperature ought not to fall below 98° F., it must not

much exceed that point, owing to the danger that too high a temperature may induce trismus. As a safeguard against injurious chilling the nurse should be taught to bathe the child by immersion. An infant's bath-tub is the most convenient vessel. The head is first to be wet, and the body is then gradually lowered into the water to the neck. The head is supported above the water by the nurse's hand. Sea-sponges should be replaced by soft cheese-cloth serviettes, which can be destroyed after once using, or if used again should first be boiled. Care must be taken that the soap used is bland and non-irritating. Most suitable is white castile or a glycerin soap; nor should even this be used too freely. The skin, too, of the new-born infant is easily injured by much friction. More harm than good will often be done by too great thoroughness in the first bathings. The duration of the bath ought not to exceed five minutes. On removal from the water the child's body is quickly dried by wrapping in a large soft towel. Little or no friction is permissible for the first week or more. The scalp and the ears must be dried carefully. The full bath may be repeated daily in warm weather, and three times weekly in the colder months. Soiled portions of the body, however, should be cleansed as often as soiled. Especial attention is to be directed to keeping the scalp clean. The best time for the bath is a morning hour, midway between feedings. If the bath is repeated before the remnant of the cord falls off, care must be taken to dry thoroughly and to re-dress the stump with dry borated cotton after each bath. It is usually better to omit the daily immersion of the child in water until the funic stump separates. Daily sponging with water or innunciations of sweet oil may be practised instead. After the navel stump comes away the umbilical wound is to be dried with care after each bath to prevent abrasions, and then to be sprinkled with boric acid, bismuth powder, or finely-powdered oxid of zinc. Should any fetor develop before the cord separates or while the wound is healing, the parts after bathing should be disinfected with the peroxid of hydrogen or other suitable disinfectant and dried before re-dressing. After one or two weeks gentle friction with the hand may be used to promote reaction after bathing. For vigorous and healthy infants the temperature of the bath may be lowered gradually to 90° F. by the age of six months.

Infant powders are not, as a rule, to be advised. Should any irritation develop in the folds of the skin, a finely-powdered talc or a powder consisting of equal parts of oxid of zinc and lycopodium may be employed. It is well to cleanse the mouth gently with pure water after nursing.

Clothing.—It is desirable that the infant's clothing be loose, with few or no pins or buttons, and capable of being easily changed. The clothing should also permit reasonable freedom of motion for the limbs. It is unnecessary to say that all parts of the body except the head ought to be protected equally. The outfit described below is a simple and suitable method of dress for the first six months.

The belly-band, which should be of the lightest material, is to be discarded after the umbilical wound has healed. It is used merely for the retention of

the navel dressing, and it serves no useful purpose after the navel has healed. It is a mistake to suppose that a tight abdominal bandage helps to prevent umbilical protrusion. On the contrary, by increasing the intra-abdominal pressure, it has the opposite effect. The belly-binder, therefore, like the rest of the child's clothing, ought to be loose enough to admit easily two or three fingers underneath it. The customary triangular napkin may be of muslin or of linen diaper. A single safety-pin here is all that need be used in the clothing. Napkin-covers of rubber, which are obviously insanitary, should never be tolerated. The clothing proper consists of an undershirt and two dresses. The undershirt should be made of the softest flannel, without sleeves and opening in front. Next is a fine flannel dress with high neck and long sleeves, cut *à la princesse*, and about 25 inches in length; this, too, opens in front. Over all is a muslin slip of a pattern similar to the flannel dress. The feet and legs are to be protected with woollen socks reaching to the knees. The undershirt and dresses may be fastened with tapes. All clothing should be laundered before using, and should be changed daily. At night the muslin and flannel slips may be replaced by a suitable night-dress. The weight of these garments is to be adjusted to the requirements of the season.

Nursing.—As a rule, when the mother's nipples are of normal size and well formed the fully-developed and healthy child instinctively suckles when first placed to the breast. Not infrequently the new-born infant does not take the nipple willingly, particularly if the nipples are small or misshapen or the child is puny or feeble. Much trouble may be saved by teaching the child to nurse before the breasts become engorged. Patience and tact will usually ensure success. Wetting the nipple with a few drops of milk squeezed from the breast, or with a little sugar and water, before applying the child may be tried if necessary to induce it to nurse.

The infant should be put to the breast as soon as the mother has rested, usually within six or eight hours after birth, and should nurse once in four hours until the milk-secretion is established. Subsequently the average interval is once in two hours. The intervals should be lengthened, as a rule, to three hours by the end of the third month, and thus continued until the sixth. About six hours should be allowed, however, between the last nursing at night and the first in the morning. From ten to twenty minutes is enough for each nursing. As the child usually falls asleep easily after its meal, it is well, if necessary, to wake it on the hour. Regularity of feeding is of the utmost importance in the interest of good digestion and proper nutrition, and the habit should be established early. It is generally best to apply the child to both breasts at each nursing. Regurgitation of food soon after feeding is usually to be taken as evidence that the stomach is overfilled. For the first two or three days after birth the child gets but little nourishment from the breasts, but it needs little. Should it become restless and fretful from hunger during this time, an occasional teaspoonful of plain water, previously boiled, will often serve to quiet its cravings. Cow's milk diluted with two volumes of water, and prepared in the manner usually practised for infant feeding,

may be given in quantities amounting to one or two ounces daily ; but a child that is fed does not so readily take the breast, and hand-feeding is therefore not, as a rule, advisable if the child is to be nursed. The best evidence of proper nutrition is a progressive gain in weight. It is a good practice to weigh the child weekly. Since a loss of several ounces usually takes place during the first few days after birth, the child does well if at the end of the week it has regained its birth-weight. After the first week, in normal conditions, its weekly gain for the first five months should not fall below five ounces.

Wet-nursing.—When for any reason maternal nursing fails or must be discontinued, the best substitute for the mother's breast is that of a suitable wet-nurse. The greatest care must be exercised in her selection. The best age is between twenty and thirty-five years. A multipara, or at least a woman who has had some experience in nursing, is to be preferred. It is desirable that the nurse's child be of about the same age as that to be nursed. A difference of a month, however, is unimportant, especially if the foster-child be the younger. A menstruating woman is sometimes undesirable, particularly if the flow be prolonged or be copious. Her breasts should be well formed, and should promptly refill after nursing. The nipples should be sound and be well developed. Women whose breasts are of a conical shape and not too large usually make the best nurses. The best evidence of the amount and quality of the nurse's milk is to be found in the way her own child thrives. In case of doubt a chemical examination of the milk may be made. It is unnecessary to say that sound health is indispensable. In addition to the direct examination, useful information may be gained on this point by consulting the physician who attended the woman in her confinement. Any serious impairment of her general health will usually disqualify—tuberculosis or syphilis always. Even after she is established in her new office her health and habits must be looked to and the child be watched to see that it thrives.

Artificial Feeding.—While there is no substitute which fully equals the natural food of the new-born infant, yet many children thrive on artificial foods : success in most cases is possible, however, only at the expense of much care and skill in the management of the feeding. The first requisite in a substitute food is the closest possible approximation to breast-milk—

1. In its physical and chemical properties ; and
2. In its freedom from bacterial organisms and the effects and products of bacterial life.

The first condition is approximately fulfilled by preparations of cow's milk with such modifications as are indicated by analyses of human milk ; the second, by proper supervision of the primal milk-supply and by the further aid of sterilization.

A defect in substitute foods prepared from cow's milk that cannot easily be obviated lies in the difference between the chemical character of its casein and that of breast-milk. The casein is somewhat more difficult of digestion than that of the human milk. The former coagulates in hard masses, while

the latter forms fine soft curds. This difficulty is partially overcome by simple dilution. But the addition of water to the point necessary to render the casein easily digestible results in a food very deficient in fat and sugar. Undiluted cow's milk, predigested, is open to the objection that it does not represent the proportions of albuminoids, fat, and sugar found in breast-milk. Moreover, feeding with predigested food is unfavorable to the development of the child's digestive powers, and its uses are therefore limited.

Human milk contains from 1 to 2 per cent. of albuminoids, from 3 to 4 per cent. of fat, and from 6 to 7 per cent. of sugar. In cow's milk the proportion of each of these ingredients is, in round numbers, 4 per cent. It will be seen by these figures that the reconstruction of the animal product requires a slight increase in the proportion of milk-sugar and a reduction in that of the albuminoids. Simple dilution is clearly not enough, since the addition of water to the point necessary to reduce the albuminoids to the required proportion yields a product which is extremely poor in fat and sugar, and entirely inadequate, therefore, for the proper nutrition of the infant. Of the various preparations of cow's milk, none more nearly meets the requirements than the Meigs mixture as modified by Rotch. The analysis of this mixture when properly prepared yields the proportions of albumin, fat, and sugar found in breast-milk. The formula for the Rotch-Meigs mixture is as follows:

Cow's milk, mixed-herd milk,	℥ij.
Cream,	℥iij.
Water, previously boiled,	℥x.
Milk-sugar,	℥vi gr. xlv.
Lime-water,	℥j.—M.

To ensure the correct percentage of fat in the mixture it is necessary that the cream used in its preparation contain 20 per cent. of fat. Such a cream will be moderately thin. It is scarcely necessary to emphasize the importance of attention to the primal milk-supply. For obvious reasons mixed milk from a herd of cows is more likely to be of uniform quality than that of one cow. Much impurity is preventable by scrupulous cleanliness in milking and in the subsequent handling of the product. Attention to the health of the animals is of primary importance, and the sooner the milk is fed after milking the better is its condition, other things being equal. The milk-sugar in the market is frequently unsuitable for use by reason of gross impurities. Care must be used to procure an article which has been fully purified by recrystallization.

Cream obtained by the ordinary method of allowing the milk to stand until the cream has risen has necessarily suffered some degree of decomposition. To be had fresh, it must be separated from milk directly after milking by means of the centrifugal machine. Unfortunately, cream by the centrifugal process is in most localities not obtainable. For a few years past a milk laboratory for the preparation of infant food has been in successful operation

in Boston under the direction of Prof. Rotch. Recently a branch laboratory has been established in New York. The milk is obtained from selected animals, with special care in collecting and handling, and is delivered at the laboratory within a few hours after milking. The cream is obtained by the centrifugal separator. Milk mixtures are compounded on the physician's prescription, with proportions of albuminoids, fat, and sugar to suit the needs of individual cases. This plan, which has been attended with signal success, marks an important advance in the scientific feeding of infants.

But these refinements in infant feeding are not always practicable, nor are they in all cases indispensable to successful nutrition. In exceptional instances the new-born child thrives on cow's milk simply diluted with one volume of water to one or two volumes of milk. A fairly good formula for a robust child is the following:

Cow's milk,	℥x.
Water, previously boiled,	℥v.
Milk-sugar, recrystallized and perfectly pure,	℥vi, gr. xlv.
Common salt,	gr. viij.
Lime-water,	℥j.—M.

The defect in this mixture is that the proportion of the albumoids is too large and that of fat too small. It usually requires further dilution for new-born infants. If not well borne, a partial predigestion may be practised for the first two or three months by the addition to the food, immediately before feeding, of $\frac{1}{2}$ grain of pancreatic extract and $\frac{3}{4}$ grain of bicarbonate of sodium to each ounce of the mixture. The use of artificial aids to digestion, however, should be limited to such exigencies as cannot otherwise be met. The digestive powers, like other functions, suffer impairment by disuse.

The addition of barley-water or oatmeal-water, gum-water, or similar admixture is advised by some writers to promote the coagulation of the casein into soft fine curds. According to Rotch, carefully-conducted experiments show that these attenuants act solely by reason of the water they contain.

As Professor Rotch remarks, the natural food of the infant in the first twelve months of its life is a purely animal food. This fact would seem a sufficient reason for excluding also all farinaceous materials from substitute foods during the first year.

Condensed milks, like ordinary cow's milk, when diluted sufficiently to reduce the proportion of albumin to the required standard, must obviously yield a result which is deficient in fat, and, in the case of unsweetened preparations, must be poor also in sugar. But this is not all. Analyses have shown that nearly all brands of condensed milk lack primarily the due proportion of fat. With one or two exceptions they are made from milk from which a portion of the cream has first been removed. Moreover, the sweet brands are sweetened with cane-sugar, which is not an ingredient of natural milk, and is, furthermore, open to the objection that it is more likely than milk-sugar to favor butyric-acid fermentation. A condensed milk, however, to which no

cane-sugar has been added, and which has been evaporated at a low temperature, provided the percentages of its nutritive constituents are known, may serve as the basis from which to construct a proper food for infant feeding. Water, cream, and sugar-of-milk are to be added in proportions which must be determined by the analysis of the particular brand of condensed milk employed.

In view of the progress that has been made in the knowledge of infant-feeding, the use of proprietary foods for infants ought long since to have been abandoned.

No less important than the proper adjustment of the principal nutritive ingredients is freedom from disease-germs and the bacteria of putrefaction. Complete sterilization is possible by prolonged boiling. Milk boiled for half an hour, and reboiled for the same length of time on the following day, will keep unchanged for several weeks. Experience, however, has shown that under prolonged exposure to temperatures near the boiling-point certain changes take place in the albuminoids of the milk by which its digestibility is greatly impaired. To so great an extent is this true that many infants are totally unable to subsist upon milk thus treated. Full sterilization of milk for infant feeding has, therefore, been practically abandoned. It is found that milk heated to 167° F. for twenty minutes and promptly chilled by placing on ice remains practically sterile for twenty-four hours, and it is spared the injurious changes which take place at higher temperatures. This process is known as *Pasteurization*. The Arnold steam-sterilizer affords a convenient means of Pasteurizing. If used with the cover removed, the steam-chamber being open, the temperature of the steam-chamber does not exceed 170° F.

The writer has found by experiments in the use of the Arnold steam-sterilizer with a suitable gas stove that the water begins to boil at the end of two minutes after the gas is lighted. A four-ounce bottle of milk at an initial temperature of 70° F. in the open steam-chamber attains a temperature of 170° in just one hour. An exposure of about an hour and twenty minutes in the steam-chamber is therefore required for Pasteurization. It is taken for granted that further details of the process require no description here.

A simple substitute for Pasteurizing consists in rapidly raising the temperature of the milk for an instant to the boiling-point, then promptly chilling the milk.

The capacity of the stomach in the infant at birth is approximately $\frac{1}{100}$ the body-weight. The average quantity of food at each meal for the new-born child is, therefore, about one ounce. The average rate of increase is $1\frac{1}{2}$ drachms per week for the first six months, subsequently somewhat less. The intervals between feedings should be about two hours at birth, and should be increased gradually to three hours by the end of the third month. These rules, however, will serve only for general guidance, and they must be modified to suit the needs of individual cases. The food should be fed at a temperature of 100° F. and directly from the sterilizing bottle.

IV. PATHOLOGY OF THE PUERPERIUM.*

I. INJURIES TO THE EXTERNAL GENITAL ORGANS FOLLOWING LABOR.

The dilatation of the parturient canal and the expulsion of the fetus and the placenta are almost always associated with more or less injury to the maternal tissues.

These injuries are usually in direct proportion to the resistance which the parts in question offer to the passage of the fetus. They are therefore, as a rule, greatest in primiparæ, and they may be absent in women that have repeatedly given birth. They are smallest in natural confinements—that is, in cases in which the forces of nature are sufficient to effect safe expulsion of the fetus in the proper time and manner—and they are greatest when a mechanical disproportion between the fetal parts and the parts of the mother, or a malposition of the fetus, or any of the numerous complications of labor, endangers either the mother or the child, and calls for operative interference (instrumental or manual) on the part of the obstetrician. They are likely to be especially great when this operative interference becomes imperative at a time when the parturient canal is only incompletely dilated.

The most common of these injuries consist in contusions and tears of the vulva, the perineum, the vagina, and the neck of the uterus; some of the rarer accidents, such as lacerations of the body of the womb, inversion of the uterus, and injuries to the pelvic bones, have been described under *Dystocia*.

Injuries to the Vulva.—At times we find transverse lacerations of the vulva that involve the deeper tissues, perforating the nymphæ and leaving them fenestrated for the rest of the patient's life, or going completely through either labia minora or majora or both, and causing these structures to hang in shreds. The most frequent accident to the vulva, however, consists in tears of the mucous membrane, which are most numerous in the vestibulum and on the inner surfaces of the labia minora. Sometimes the tears are near the urethral orifice or they extend into it, and under these conditions will cause a burning pain during urination or will lead to retention of urine on account of the accompanying swelling. These injuries do not, as a rule, cause much hemorrhage, but at times they will do so, especially if one of the convolutions of blood-vessels known as the *bulbs of the vestibule* is involved.

Treatment.—Superficial tears of the mucous membrane of the vulva will heal without much treatment. They should be kept clean and may be dusted with iodoform. All deeper lacerations and those followed by hemorrhage are best closed by fine silk sutures. Union by first intention takes place almost invariably, and the stitches may be removed on the fourth or the fifth day. When there is retention of urine it may become necessary to use the catheter

* The superior figures (¹) occurring throughout the text of this section refer to the bibliography given on page 804.

until the swelling has subsided. Often, however, the patient will be enabled

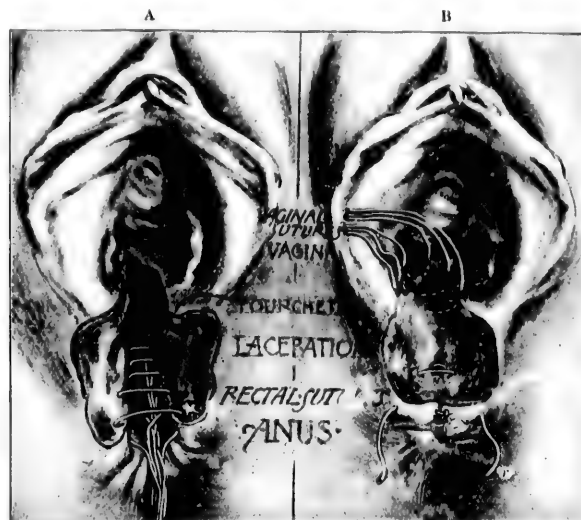


FIG. 413.—Perineal lacerations: A, laceration extending through the sphincter (*s*) into the rectum, stitches introduced through torn margins of rectum and through ends of sphincter (*s*), ready to be tied with the knots in the rectum. B, sutures in rectal tear tied; reinforcing stitch (*r*) passed through ends of sphincter and appearing at apex of rectal tear, ready to be tied; vaginal sutures also placed.

to urinate spontaneously if the vulva is well cleansed with some warm antiseptic solution, and a bed-pan half filled with hot water or with hot chamomile tea is placed under the pelvis in such a manner that the vapor comes in contact with the swollen parts.

Injuries to the Perineum.—Ruptures of the perineum constitute the commonest injuries of labor. In primiparae the frenulum tears almost always, and more extensive lacerations will occur in at least one-third of the cases. In multiparae the lacerations are less frequent and are usually less formidable; they may be avoided altogether in nine cases out of ten.

For practical purposes lacerations of the perineum are divided into lacerations of the first, the second, and the third degree, according to their extent. Whenever one-half of the perineum is left uninjured, the laceration is one of the *first* degree. When the tear extends farther back, even as far as the sphincter ani, but without involving that structure, then there is a laceration of the *second* degree. The lacerations of the *third* degree, also called



FIG. 414.—Vaginal and rectal sutures tied; sutures placed to repair perineal body.

"complete ruptures of the perineum," extend through the sphincter ani into the rectum (Figs. 413, 414). At times we meet with a laceration of the perineum that cannot be brought under either of these headings. We refer to the so-called "central rupture," in which the anterior and the posterior boundaries of the perineum remain uninjured, while the central portion becomes torn and perforated and may even afford passage to the fetus.

In addition to the perineal lacerations just enumerated, tears extending up one or both lateral sulci of the vagina (Fig. 415) are of very frequent occur-

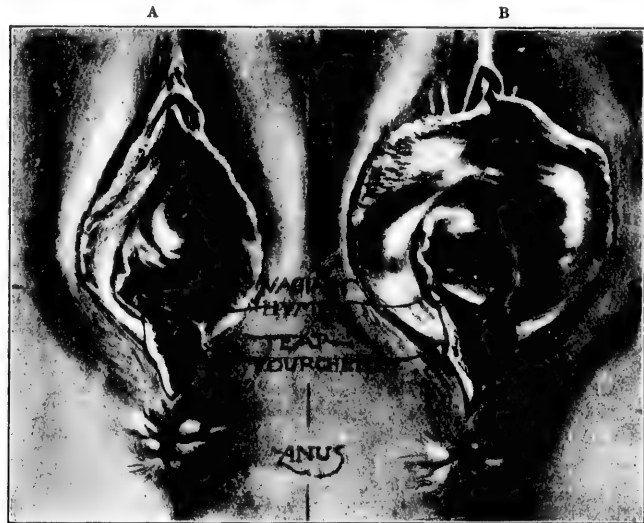


FIG. 415.—Perineal lacerations: A, laceration extending up right lateral sulcus. B, laceration involving both lateral sulci.

rence, and the resulting injury to the levatores ani muscles destroys in varying degree the subsequent usefulness of these structures as supports to the pelvic viscera. Indeed, this type of so-called "perineal laceration" is perhaps of greatest importance, since it is the factor which more than any other determines subsequent relaxation and consequent displacement of the pelvic organs. It should also be remembered that the integrity of the levatores ani muscles may be destroyed by being over-stretched without apparent laceration of the superimposed vaginal tissues.

Causes.—In primiparæ with the best of care and under perfectly normal conditions ruptures of the perineum cannot altogether be avoided. No matter how much softened and how yielding the parts become, the passage of the fetal head forces the vulvar ring so far open that in most cases there will be a giving way of tissue at the moment when the greatest diameter of the child's head passes this ring. In vertex presentations, with rotation of the occiput forward, this moment arrives after the greater fontanelle has appeared in front of the frenulum, the fetal head going through the pelvic outlet with its lesser

oblique diameter. In all other presentations the chances for rupture are very much increased. They are greatest in face presentations, in which the chin has to rotate forward and the head leaves the vulva in its greatest diameter, the greater oblique. The causes of the rupture are also frequently found in the peculiarity of the maternal tissues. Small women with narrow vaginal openings may give birth to good-sized children and escape with scarcely a scratch, the parts possessing a wonderful elasticity; while in other women perfectly healthy, and having the parts of good dimensions and apparently quite elastic, the parts tear easily and extensively when the test comes. In still other cases the conditions are such that we know beforehand that the elasticity of the parts is below the average. This absence of elasticity is usually found in elderly primiparæ, especially when they are above thirty-five years of age. Moreover, a protracted labor will make the perineum dry and unyielding, or it may cause an edematous or inflammatory swelling, which in turn frustrates all efforts on the part of the obstetrician to avoid a rupture. A proper guarding of the perineum and a slow transit of the fetus through the pelvic outlet tend to avoid lacerations. Precipitate labors and labors without skilled assistance must therefore increase the chances for such injuries.

Symptoms.—A burning pain is usually the only symptom that a lacerated perineum causes at the time of its occurrence. In some few cases there is free hemorrhage from torn blood-vessels, but these cases are exceptions, and the bleeding generally does not amount to more than a free oozing of blood from the raw surfaces. If left to themselves, most ruptures of the first and second degree will heal spontaneously; the more extensive ones will heal by granulation and cicatrization, leaving the parts in an unyielding condition for subsequent labors. The ruptures of the third degree extending into the rectum and



FIG. 416.—Complete prolapse of the uterus and vaginal walls following extensive and ununited perineal laceration.

those involving the levatores ani muscles seldom heal spontaneously. The later consequences of an ununited perineal laceration are a gradual descension of the vagina and uterus, starting with prolapsus of the anterior vaginal wall, and often ending with complete inversion of the vagina and complete prolapsus of

the uterus, so that there is found in front of the pelvic outlet a large tumor, the covering of which is formed by the vaginal mucous membrane except at the apex, where the os uteri externum is visible. The body of the uterus is found inside this tumor (Fig. 416). In complete ruptures the impairment of the sphincter ani makes it impossible for the patient to control the passage of gases and of liquid fecal matter, and it renders her condition so miserable that she usually applies for a surgical restoration of the injured parts long before a prolapsus has had time to develop. The principal danger, however, from lacerations of the perineum of any degree is found in the great liability they offer to septic infections of all kinds during the lying-in state. The lacerations form large raw surfaces which are ready to absorb and to carry into the system any infectious material that may be brought near them. Thus, infection from outside sources, such as may be communicated by the hands or the instruments of physicians and nurses, will take place with greater facility and surety when the perineum is torn than if the *materia peccans* would have to reach the cervix uteri before it could find an easy entrance into the lymphatic and vascular systems. The experiments of Kehrer of Heidelberg have demonstrated that the lochial discharge of healthy puerperæ contains pyrogenic and phlogogenic elements; thus we find that lying-in women with perineal rupture have fever from absorption of the normal lochial discharge while passing over the raw wounds. This fever subsides as soon as healthy granulations spring up to form a living barrier against further absorption. If the lochial flow becomes offensive from any cause, then its absorption will not produce simple elevation of temperature, but will be followed by puerperal septicemia with more or less local manifestations.

Treatment.—The first object of the treatment of lacerations of the perineum must consist in trying to avert them, or where this not practicable at least to limit their extent so far as possible. Supporting the perineum at the time the head passes, securing the proper mechanism at the moment of its delivery, and, most important of all, resisting too rapid expulsion by forcibly retarding the expulsion of the head and by crowding the latter well against the under surface of the symphysis, will often avoid extensive laceration. The details of managing the birth of the head and the methods to be employed to avert serious injury to the pelvic floor have been described and illustrated on page 369. During the passage of the shoulders the support must be continued, for often the passage of the head causes just the smallest tear, perhaps extending only through the frenulum, and, if the shoulders are carelessly allowed to pass, this tear may be increased to great dimensions.

When the uterine contractions are so violent that they tend to force the fetal head out with great rapidity, they should be regulated by a hypodermatic injection of morphin, or, still better, by inhalations of chloroform. If a rupture of the perineum is apprehended, it is advisable to deliver in the lateral position (see illustration, p. 372). The passage of the head will be slower than in the dorsal position, and the parturient woman can use less force in bearing down. The perineum can be more closely observed, and, in suitable cases, an

impending laceration may be avoided by the so-called "bilateral incisions" or episiotomy, an operation described and illustrated on page 373 (see Fig. 202). Many a laceration of the perineum may thus be avoided, and a clean incised wound, which can easily be united by one or two sutures, is substituted for a torn wound, whose extent could not be foreseen.

In cases in which the perineum appears rigid, warm moist applications during labor will help to soften the parts; chloroform-inhalations carried to complete anesthesia seem also to render the tissues more yielding. Where the delivery is accomplished by the aid of forceps, an impending rupture of the perineum may be avoided by taking off the instrument just before the greatest diameter of the child's head passes the pelvic outlet; otherwise the instrument will help to augment the distention of the vulvar ring and will make a laceration more probable. If the forceps, however, is not removed, it should be used to hold the head back during expulsive efforts and thus permit gradual dilatation of the vaginal outlet.

When these prophylactic measures fail to prevent a rupture of the perineum, it becomes the duty of the obstetrician to see that the injury is repaired in the manner previously described (page 379) and immediately after the completion of labor. No physician should attend a case of labor without carrying in his satchel the necessary implements for suturing perineal lacerations.

Complete lacerations are the only cases in which a good obstetrician may defer repairing the injury until he can obtain skilled assistance, yet it is desirable that they should be attended to within twenty-four hours after delivery.

The after-treatment is very simple, and is usually limited to irrigations of the wound with an antiseptic wash and to keeping the parts covered with proper dressings, being careful, if the syringe-nozzle is introduced into the vagina, to avoid separating the surfaces of the wound that the sutures have approximated. The external or perineal sutures are removed between the fifth and the seventh day, while the vaginal and rectal sutures may be left in place a little longer. Treated in the way previously described, about 75 per cent. of lacerations of the perineum will heal by first intention. In some cases the union will be incomplete, and part of the defect will have to be made good by granulation.

Sometimes the tissues of the vulva are in such a bruised, swollen, and unhealthy condition that a union of the parts cannot be expected; it is better in these cases not to attempt closing up by sutures. At other times, the parts having been sewed up, there develop symptoms of puerperal infection which make it necessary to reopen the wound; as, for instance, when the lochial discharge has found its way between the wound-edges and is entering the system through pockets which cannot be disinfected without laying the parts well open. In the latter cases the wound has to be frequently irrigated with antiseptic solutions, and the formation of granulations must be assisted as much as possible by the lavish use of powdered iodoform. Whenever the wound-surface looks unhealthy and is covered with a grayish coating (diphtheritic plaques), applications of the following dressing will be found of the greatest service:

R. Olei terebinthinæ, ʒij;
Olei olivæ, ʒiij.—M.
Sig. Locally.

Not only does the spirit of turpentine act as a good antiseptic agent and as a powerful promoter of granulations, but it also acts as a stimulant to the general system, and its use is therefore perfectly safe even in those low conditions in which the free application of some one of the other antiseptic remedies might be fraught with danger. The mode of applying the turpentine is simple. After the wound has been cleansed by irrigations, its edges are well separated by the hand and a flat layer of absorbent cotton soaked in the turpentine mixture is introduced between them. The dressing is renewed three or four times a day until the surface of the wound is entirely covered by granulations, when the ordinary treatment may be resumed.

Injuries to the Vagina.—With deep perineal ruptures there is always more or less laceration of the posterior vaginal wall (see page 674), but there are also found tears of the vagina that are not so connected. These injuries may be superficial, involving the mucous membrane only, or they may extend through the muscular coat of the vagina, laying open the pelvic cellular tissue or penetrating into the surrounding viscera. If the injury is located at the upper portion of the posterior vaginal wall, the peritoneum may be exposed or the abdominal cavity may be opened.

After protracted labors, especially when there is a narrow pelvis or a disproportionately large child, we sometimes find contusions of the vagina that later on cause sloughing of the mucous membrane, followed by cicatrization and constriction of the entire vaginal canal. At other times circumscribed portions of the upper vagina have been contused to such a degree that in a very few days they become necrotic and lead to perforations of the wall. These injuries are particularly likely to happen when in a flat pelvis the fetal head has for hours been wedged in between the symphysis pubis and the promontory. The pressure-marks in the vagina correspond in such cases with similar marks on the fetal head (see Fig. 315, p. 513); they are of round or oval form, measuring from 1 to 2 centimeters ($\frac{3}{8}$ to $\frac{1}{2}$ inch) in diameter, and, becoming gangrenous, ultimately produce vesico-vaginal or recto-vaginal fistule, as the case may be. At times we meet with submucous lacerations of the vaginal wall, resulting in the formation of more or less extensive hematoma.

Causes.—A narrow and unyielding vagina, especially in primiparæ of advanced age, will often be the cause of these injuries. A rapid passage of the fetal head, an over-distention of the parts by abnormal positions of the fetus, will also work in the same direction. Sometimes the vagina is ripped open by undue sharpness and projection of the spines of the ischium or by abnormal excrescences of the pelvic bones. At other times the injury has been brought about by splinters of fetal bones present during craniotomy or embryotomy. The most extensive laceration of the vagina ever observed by the writer was caused by the use of the forceps in unskilled hands. An elderly primipara was

delivered by a midwife, who had not only applied forceps, but had also sewed up in the rudest manner an extensive perineal laceration. The writer saw the patient four days after the operation, and found in the middle portion of the vagina, backward and to the left, a longitudinal gap through which could be passed the entire hand into a cavity filled with coagulated blood.

Symptoms.—Injuries of the vagina do not at first cause much disturbance unless there be a free hemorrhage; in the rare cases in which the peritoneum has been injured, the symptoms of peritoneal irritation, such as pain and nausea, will not be missing.

Prognosis.—Deep lacerations of the vagina are of grave importance. They allow the direct entrance of the lochial discharge into the cellular tissue, and are therefore very often followed by pelvic inflammation and by pelvic abscess. The contused wounds often cause extensive sloughing of the vaginal mucous membrane, and lead later on, by cicatrization, to a stricture of the vagina that may approach an occlusion. Necrosis of circumscribed regions of the vaginal wall lead, as already mentioned, to the formation of vaginal fistulæ.

A hematoma usually disappears without leaving bad effects, but at times its contents decompose and threaten the general system with septic infection.

Superficial lacerations may heal spontaneously without causing any symptoms, but more frequently they become infected by the lochial flow, and are changed into puerperal ulcers which cause more or less disturbance, and which finally heal by granulation, leaving in the vaginal wall a scar which in subsequent labors may prove the source of further trouble.

Treatment.—Lacerations of the vaginal mucous membrane, if in any degree extensive, should always be united by sutures if recognized soon after their occurrence, and they will usually heal by first intention. Penetrating wounds with escape of blood or of secretions into the cellular tissue are kept clean by frequent irrigations with antiseptic solutions, followed by packing the wound-cavity with iodoform gauze. After severe contusions with unavoidable sloughing of the mucous membrane the patient can often be kept free from septic infection by the use of permanent irrigations. For this purpose a large tank or irrigator is filled with sterilized water and placed near the bed, at a height not exceeding 60 centimeters (2 feet) above the patient's genitalia; a vaginal tube, which is best made of glass, is connected with the tank by rubber tubing, and the flow is controlled by a faucet. The patient is placed on an air-cushion over a bed-pan (or a tin box made for the purpose), which in turn has a waste-tube leading to a larger vessel on the floor. The faucet is so set as to allow the water to flow very slowly or merely to trickle; the tube is inserted into the vagina and is kept in position by tapes tied around the thigh or the waist of the patient; the vulva is covered with antiseptic dressings. In this way a little stream of sterilized water is kept running over the contused parts, washing away the lochial flow and every particle of débris as soon as formed. Several times a day an antiseptic wash is placed in the tank and a full stream is turned on, to give the parts a thorough disinfection. Most patients can stand this treatment for twenty-four hours and longer; they pass the urine

without necessitating a stop in the irrigation, and they rest quite comfortably. Others complain so much of discomfort that the irrigation cannot be continued for more than three or four hours at a time, but even in this imperfect application it will do a great deal of good.

Hematoma.—Subcutaneous and interstitial bleeding, forming a circumscribed blood-tumor, is a rare complication of the puerperium that may be attended with considerable danger. Since the monograph of Deneux, all systematic writers on obstetrics have discussed these blood-formations, and the only new feature that modern obstetrics has added to the subject is a lowered mortality under the newer antiseptic methods of treatment. This accident, which is rare, occurring once in about 1600 labors, is commonly caused by pressure-laceration or necrosis of one or more veins which have not been able to withstand the strain of the increased venous pressure occurring during labor. Exceptionally the rupture has occurred in the latter part of pregnancy, and very rarely the torn vessel may be an artery, as in a case reported by Simon.

Etiology.—Several conditions have been reported as predisposing causes, the most important, doubtless, being weakening of the vessel-wall by disease. Varicose veins of the vulva and vagina are of common occurrence, and, *a priori*, they would seem to predispose to this accident, yet the rarity of hematomata and the fact that most cases have not been preceded by markedly varicose veins force the conclusion that in themselves they are not a factor of first importance. Croom has asserted that anterior displacement of the uterus, producing a pendulous abdomen, is a factor by stretching the posterior vaginal wall and tearing its vessels before the head descends into the pelvic canal. Hypertrophy of the cervix, the use of instruments, excessive size of the head, undue length of the labor, and prolonged and powerful expulsive efforts have been said to favor the occurrence of hematomata.

Symptoms and Signs.—The swelling formed by the extravasated blood usually does not appear until labor is ended, and in some cases even several days later, the time of its appearance depending upon the kind of injury the veins have received. When the vessel has been ruptured early and the presenting part has not advanced sufficiently to exert direct pressure upon the injured veins, the tumor appears at once, and, immediately reaching its full size, may seriously obstruct labor; if, however, the presenting part exerts sufficient pressure to control the bleeding temporarily, the tumor may be very small or may not be noticed until after labor. When the vein which is subjected to prolonged compression is only contused, and which later gives way either spontaneously or after sudden exertion, as coughing, straining at stool, or during micturition, the tumor first appears in the puerperium, usually within a day or two, but very rarely so late as the twenty-first day, as in a case reported by Helfer. The situation of the tumor varies; anatomically it is determined by the distribution of the fascia, either of the pelvis or of the perineum. Usually the blood is effused below the pelvic fascia, and the tumor appears in the labium, or beneath the vagina, or in the perineum, extending exceptionally to the anus, to the gluteal region, and in front to the abdominal

walls. If the bleeding has occurred above the pelvic fascia, the effused blood may be situated in the broad ligaments or the periuterine connective tissue, and it may extend even to the diaphragm. Very rarely the tumor may be found in the cervix. Clinically, the commonest site of the swelling is at the side of the vagina near the vulva. The size of the tumor also varies. Usually not larger than an egg or one's fist, the tumor may be as large as a cocoanut, or, widely distributed, it may contain a very large quantity of blood. A hematoma, polypoid in shape, has been observed hanging from the vagina.

The formation of a hematoma is generally accompanied by pain in the region affected, this pain being very severe when a large tumor is formed. There are at the same time constitutional evidences of hemorrhage that also vary in their severity in direct proportion to the volume of the tumor. Should the swelling reach its full volume at once, and burst—an unusual complication—the loss of blood may rapidly be fatal. In some instances the tumor continues to enlarge for twenty-four hours. Soon after its formation it assumes a livid or mottled appearance, at first giving tense fluctuation, but later a clot-like firmness. By pressing upon the bowel or the bladder the functions of these organs may seriously be interfered with, and when the swelling reaches a considerable size during labor it may impede the birth of the child or the placenta, and later may obstruct the lochial flow. The symptoms being practically characteristic, the *diagnosis*, therefore, is generally easy when the tumor is visible or is easily accessible in the lower parturient tract. The tumor might be mistaken for prolapse or inversion of the uterus or the vagina, for varicose veins, or for vaginal enterocele. When the effusion has taken place within the pelvis, the diagnosis will be made by a bimanual examination, together with the mode of onset and the constitutional signs of internal hemorrhage.

The termination of a hematoma may be any one of the following: (a) Absorption; (b) recovery after evacuation of its contents; (c) septic infection before or after rupture; (d) hemorrhage, which may prove rapidly fatal before rupture or at the time of rupture. Rupture may be the result of undue or sudden effort, or, at a later period, it may occur spontaneously from sloughing. The ultimate result, which in any case will depend upon the size and situation of the tumor, is also largely influenced by the treatment pursued. Small tumors not larger than an orange are usually absorbed, while those of larger size frequently burst spontaneously and thus add to their gravity. Of 30 cases collected by Winkel, twenty-three spontaneous ruptures occurred within eight days. If, on the one hand, the larger tumors are opened before necrotic changes or renewed hemorrhages have occurred, the prognosis is favorable, and with rigid antiseptic treatment death should be exceptional; if, on the other hand, delay permits such changes, the mortality is 12 per cent. (Winkel).

The situation of the tumor influences the prognosis to the extent of its being accessible, and thus being more readily dealt with. Intrapelvic tumors, therefore, are more dangerous, the hemorrhage being less readily controlled and the danger of suppuration being greater. Tumors appearing during labor have had a higher mortality than those occurring after delivery.

The treatment of a hematoma varies with the time of its appearance, its size, and its situation.

Should the swelling occur before or during labor, and offer a serious obstruction to the passage of the child, the tumor should be laid open in its dependent portion, to favor subsequent drainage, preparations having previously been made to control the free hemorrhage almost certain to follow evacuation at this time. Manual compression by an intelligent assistant can be utilized to control free bleeding while the bleeding vessels are being searched for and ligated. If this cannot be done readily, forceps should be used to draw the head into the vagina until by the pressure of the head the bleeding is controlled. Even when the tumor is not large enough to impede the passage of the child, it is best to anesthetize the patient to prevent excessive straining on her part, and to apply the forceps and to employ cautious extraction to prevent further bleeding and increase in the size of the swelling. If the forceps is not employed, or in case the swelling first appears after labor, an attempt should be made to control the hemorrhage by the application of cold and by pressure, both of which can conveniently, and usually effectually be applied by means of the largest Barnes' bag or by a colpeurynter placed in the vagina and filled with ice-water, ice poultices being placed against the labium. If the swelling ceases to enlarge—an indication that bleeding has been controlled—and if the tumor is not larger than one's fist, efforts should be made to promote its absorption by cooling applications, such as compresses wet with lead-and-opium wash or with diluted alcohol. Meanwhile the vagina must be kept clean by frequent antiseptic douches, and the patient should be cautioned to avoid all efforts at straining. It is therefore desirable to use the catheter and to keep the stools soluble.

After waiting a few days, if there are no signs of absorption, and if the tumor, which had been hard, now becomes soft, and the overlying skin or mucous membrane is tense, discolored, or vesicated, indicating, as these changes do, beginning suppuration or threatening spontaneous rupture, the time has arrived for prompt evacuation of the tumor. An incision 5 to 7.5 centimeters (2 to 3 inches) in length should be made along the inner surface of the labium, the clots turned out, bleeding vessels ligated, and the cavity daily cleansed and packed with antiseptic gauze.

When symptoms of internal bleeding and physical examination point to the occurrence of a hematoma within the pelvis, care must be taken to exclude free hemorrhage in the peritoneal cavity from a ruptured broad ligament or other vein, since the latter condition would necessitate opening the abdomen, while in the former, if the hemorrhage is confined within the connective tissue, the shock and collapse should be combated, and effort be made to limit the hemorrhage by cold and by the internal administration of hemostatics. Subsequently the tumor should be watched, and, if not absorbed, it is best to evacuate it through the vagina. If not extensive, and if there are no marked constitutional evidences of internal bleeding, the condition will probably go unrecognized until spontaneous evacuation occurs or until incision

is made after several weeks or months, as in a case of Tergrigorianz, in which case a broad-ligament hematoma through pressure-necrosis communicated with the posterior vaginal vault, and was emptied of stinking, bloody fluid after four months.

II. DISEASES OF THE SEXUAL ORGANS.

1. PUERPERAL INFECTION.

By "puerperal infection" is here understood all the manifold diseases conditions in a puerperal woman caused by microbes except eruptive fevers; non-inflammatory diseases of the nervous system, such as tetanus, tetany, and insanity; and inflammation of the breasts,—all of which are discussed in other parts of this work.

Puerperal infection in almost all cases is a wound-infection, and, just as this may be slight or be serious, puerperal infection may be a local affection of the external genitals of little importance; or it may be a more serious affection of the internal genitals, especially the uterus; or the whole system may be drawn into the morbid process. In most books this condition is treated of under the name "puerperal fever," a denomination from which the writer entirely abstains, for the reason that it is absolutely impossible to draw a distinct line anywhere on this field as a limit for something worthy of that name. The old idea of puerperal fever as an essential fever, a nosological entity *sui generis*, is given up by all. It is impossible to define puerperal fever, and it ought to follow the terms dropsy, lung fever, and brain fever, which have long ago been relegated to the scientific lumber-room for terms fallen into desuetude and given way for definite and correct expressions. The term "puerperal fever" ought the less to remain in scientific language as in some of the worst cases there is no fever at all.

Of late years, instead of "puerperal fever," the term "puerperal septicemia" is used by many, which is certainly an improvement, in so far as it reminds us of the identity of puerperal infection with wound-infection; but the expression is both too wide and too narrow for our purposes—too wide, because the same word has a more restricted sense of a certain form of puerperal infection in contradistinction to other forms; too narrow, because the word by its etymology means a condition where septic material circulates with the blood through the whole body, and because the term cannot properly be made to encompass many diseased conditions found in the puerperal woman, which conditions in most cases never lead to a general infection of the whole system.

The term "puerperal infection" is open to the criticism that it means a cause, and not the effect produced by this cause, but this is not without analogy in common parlance. The word "cold" meant originally a low temperature, but by extension it has been made to comprise as well the disturbance in the human body caused by exposure.

By using the expression "puerperal infection" to designate the diseased

conditions produced by infection during pregnancy, childbirth, and the puerperal state we have the advantage of having a general term which covers the whole ground, mild and serious cases, local and general disturbances in the equilibrium of health. We are furthermore reminded of the possibility of guarding our patients against a pest that not long ago was thought to be due to a deterioration of the atmosphere, or even to a direct retribution of an irate deity; and we are turned in the right direction for finding therapeutical relief for evils already existing. We stand also on pure scientific ground, since all modern research proves that in the mildest and in the severest cases the morbid element is the same—namely, the presence of the different species of *staphylococcus pyogenes* (Fig. 417) and the *streptococcus pyogenes* (Fig. 418).

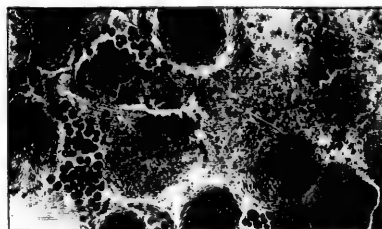


FIG. 417.—*Staphylococcus pyogenes aureus* in pus ($\times 1000$) (Fränkel and Pfeiffer).

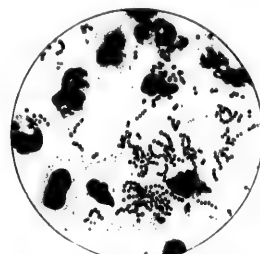


FIG. 418.—*Streptococcus pyogenes* in pus ($\times 1000$) (Fränkel and Pfeiffer).

The celebrated French microscopist Cornil¹ states that the streptococci found in patients affected with so-called "puerperal fever" are the same as those first described by Fehleisen as the cause of erysipelas. He found the same coccus in all the different forms of puerperal infection—pyemia, septiemia, the diphtheritic and the phlebitic form. Only once did he find a rod-shaped bacillus.

Clivio and Monti of Pavia² found in five cases of puerperal peritonitis in the fluid contained in the abdomen a streptococcus which was identical with Fehleisen's streptococcus of erysipelas and with Rosenbach's streptococcus of suppuration, and similar streptococci were found in phlegmonous abscesses in other diseases. Lustig of Turin³ found this same streptococcus in the blood of the spleens and the hearts of women who died from puerperal endometritis and peritonitis.

Bumm,⁴ who made extensive researches with ample material, likewise arrives at the conclusion that the streptococci found in puerperal infection are identical with those found in infected wounds. Mirónow⁵ also identified the streptococcus of erysipelas with that gathered from the uterus of sick puerperal women.

Doyen, Cushing, Bumm, and others⁶ found that puerperal infection may be due to other cocci. Döderlein⁷ found the streptococcus pyogenes to be the most important, but, besides, that the pyogenic staphylococci are active.

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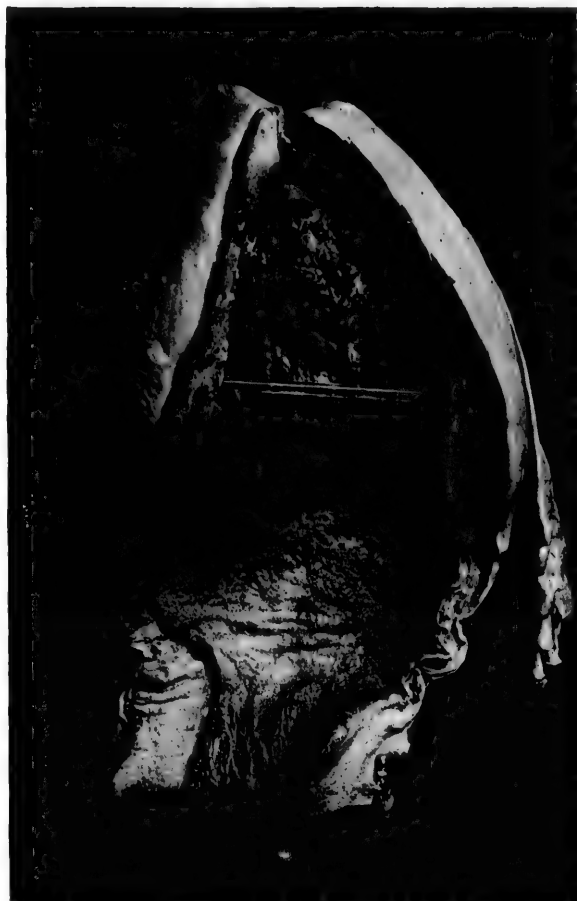
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Specimen from a patient who died septic, showing the material that would be found to be removed by the curette or the finger on the "roughened placental site." "Clots in the uterine sinuses" (Army Medical Museum, Washington, D. C., No. 10,619).



Puerperal fever, so called, is therefore not a nosological entity, but is a complex phenomenon due to different microbes.

Different Forms of Infection.—First of all, we must distinguish between mere *local* affections and a *general* infection reaching the whole system. The former are, of course, much less dangerous than the latter. Next, we must separate the *putrid* from the genuine *septic* infection, both of which may be local or be general. General putrid infection is called *sapremia*, and general septic infection is called *septicemia*.

Putrefaction and sapremia are due to many different schizomycetes, the so-called *saprophytes*—minute organisms which are allied to algae, and are found all over the world in streams, plants, animals, etc. By their growth and multiplication these organisms produce certain chemical substances, the so-called *toxins*, a kind of ptomaines which give rise to fever. *Ptomaines* are alkaloids produced in dead vegetable and animal tissues during putrefaction; *leucomaines* are similar alkaloids produced in living animal tissues as a result of their activity. Ptomaines are only produced by microbes. Leucomaines are harmless unless their excretion is interfered with.

The changes occurring in puerperal infection may be produced by ptomaines or by leucomaines alone, without the presence of microbes, but in the vast majority of cases the microbes are present. The saprophytes are generally brought into the interior of the uterus mechanically.

Septicemia is due to a few well-known microbes that actively enter the tissues, which they injure through their growth, and by their distribution throughout the body may so change the chemical processes and normal functions that death ensues. These microbes are, as we have stated, almost exclusively streptococci, and are identical with those that cause wound-diseases; and in the second line come staphylococci. The latter two varieties of microbes are therefore also called *pathogenic* microbes, which give rise to so-called *specific* puerperal diseases, and which are different from the so-called *non-pathogenic* microbes, that only cause putrefaction and *non-specific* puerperal disease.

The infection starts, in the vast majority of cases, from the endometrium. Bumm⁸ distinguishes, in accordance with what has just been said, a *putrid* from a *septic endometritis*, but he admits that in some cases the two forms are blended. In *putrid endometritis* there is found in the uterus a superficial layer of necrotic tissue, under which is a layer of granulation-tissue filled with leucocytes, those formerly much-maligned colorless blood-corpuscles that have since the advent of bacteriological studies proved to be our truest friends, forming a bodyguard that protects us against the constant attacks of our enemies, the microbes, whom their minute bodies engulf and absorb. Hence they have received the name of "phagocytes;" that is, "devouring cells," a species of giant-killers on a small scale. While the necrobiotic layer is covered with all kinds of saprophytic bacilli and cocci, these never enter the granulation layer.

Septic endometritis differs according to its being a local affection or an

inflammation followed by general infection. In *local septic endometritis* the endometrium is much like that in putrid endometritis, except that, besides more or less numerous germs of putrefaction, streptococci are found.

General septic endometritis appears under two different forms—the *lymphatic* and the *thrombo-phlebitic*. In the *lymphatic* form there is a mixture of saprophytes and streptococci on the necrotic surface, but the granulation-wall is much thinner than in putrid endometritis, and in the worst form of sepsis it is altogether absent. On the placental site the veins are well closed, their walls being in contact and without thrombi. In the severest cases the infection-carriers go through the finest lymph-spaces between the tissue-elements. In less rapid cases they generally follow the larger lymph-vessels. From the wall of the lymph-vessels they enter the surrounding tissue, causing necrosis. The lymphatic form often starts from injuries of the cervix.

In the *thrombo-phlebitic* form of general infection the endometrium is like that of localized endometritis, the germs never entering the layer of granulation tissue filled with leucocytes except at the placental site. Here the veins have not been closed by collapse and apposition of their walls—the normal process—but are plugged with thrombi. In some of these thrombi we find, superficially, saprophytes and streptococci, but the latter, finding a favorable soil in the thrombi, enter into their interior, while the saprophytes remain near the surface. The invaded thrombus soon forms a detritus, a process that extends into the broad ligament. The thrombo-phlebitic is a more rapid and a more dangerous form. In septic peritonitis the infection is not propagated through the Fallopian tubes, but it takes place through the lymphatics of the walls of the uterus.

The *diphtheritic form* of puerperal infection begins in the mucous membrane of the vulva, vagina, or uterus, or in a tear extending into the surrounding connective or muscular tissue, and patches, like those found in a diphtheritic wound or in the throat of a patient affected with diphtheria, are formed. It is again the same streptococcus that is at work, and the affection passes into one of the above-described forms.

The difference in symptoms and in the danger in different cases of puerperal infection may be accounted for in many ways. The different power of resistance may count for something, one organism succumbing to an attack which a stronger constitution successfully resists. The mere number of microbes seems to be of importance in all infections, the invaded body being capable of neutralizing a small number, but losing in the battle with the many.

The anatomical structure and connections of the part invaded explain many peculiarities in the result produced. An infection attacking one lymph-vessel leading to a gland may be cut short there, while if the infecting material enters another lymph-vessel it is carried to the peritoneum, thence, perhaps, through the stomata of the diaphragm to the pericardium and the pleura. Or a thrombus in a vein breaks down, and part of the detritus is carried away with the blood-current through the vena cava, the right auricle, the right ventricle, and

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Uterus with shreddy material (M, S) and sloughing strip "encircling internal os" (S, S); from a girl of nineteen who died eight days post-partum with puerperal peritonitis (Army Medical Museum, Washington, D. C., No. 8057).





Portion of placenta (*in situ*) remaining *in utero*; death from sepsis five days after delivery in a typhoid condition. Colored girl, nineteen years old, syphilitic, with dead fetus at term (Army Medical Museum, Washington, D. C., No. 7784).



is deposited in a fine branch of the pulmonary artery, forming an abscess, from which the microbes are carried to other parts of the body to form new foci of suppuration.

Most important of all seem to be the different degrees of virulence of the microbes themselves. Virulence is a property of the protoplasm that shows itself in energetic proliferation and increased power of resisting the influence of the cells in the organism invaded. This virulence is diminished by artificial culture, and is increased in the animal body, but in what way is unknown. The virulent streptococcus rapidly invades the tissues.

Infection starting from the genitals takes place through a wound, many microbes being found in the genital tract of every puerpera, besides the placental site, which has been compared to the stump left after the amputation of a limb. It is not so in animals. With animals, as a rule, the process of expelling their offspring is not more difficult than the act of defecation, and their placental site either regains its epithelium before the loosening of the placenta, or recovers it in a very short time after delivery, almost in minutes. This fact explains why puerperal infection is not produced in an animal by the injection of septic fluid into its vagina and uterus. As soon, however, as the same fluid is injected under the mucous membrane infection follows.⁹

In the opinion of the writer the so-called "puerperal fever" is nothing but the most serious form of puerperal infection. Localized is less dangerous than general infection; putrid infection is not so important as septic infection; but any local infection may become a general infection, and putrid infection may end in death.

Septicemia in Children.—Identically the same disease above described in puerperæ is often found in new-born children. The mother of the child may or may not have the disease. Infection in the child generally takes place through the navel, but it may enter through sores in the mouth or through an accidental wound, or it may be aspirated into the lungs in the putrid liquor amnii or be inhaled through the air, or it may even pass from mother to child through the placenta. If not acquired from the mother before birth, the poison may be carried to the child by doctors or by nurses, or may cling to any object with which it comes in contact, or may float in the air. The sources of the poison in children are the same as those we shall now describe in regard to the mothers.

ETIOLOGY.—Experience shows that a puerpera is more liable to disease than is a woman in other conditions, and it is not difficult to give many good reasons why this must be so. The causes of puerperal infection are *predisposing* or *exciting*.

Predisposing Causes.—During pregnancy the chemical composition of the blood undergoes considerable change; the total amount of blood circulating in the body increases, but it is more watery than in the non-pregnant condition. In other words, the woman suffers from plethora and hydremia. The red blood-corpuscles diminish, while the colorless corpuscles increase in number. Hemoglobin, albumin, fat, phosphorus, and iron are found in too small amount, whereas the quantity of fibrin is considerably greater than in the

non-pregnant woman. The plethora, hyperinosis, and leucocythemia predispose to inflammation.

The heart, especially the left ventricle, becomes hypertrophic. The walls of the blood-vessels become thicker and their calibre larger, especially those in the uterus and the breasts. The lymphatics of the pelvis become so dilated that they look like veins. This dilatation of blood- and lymph-vessels predisposes to the formation of thrombi, which not only constitute a fertile soil for the pathogenic microbes, but also may break down and be carried away by the circulation to remote parts that become new centres of infection. The muscular tissue of the uterus grows enormously in order to afford room for sheltering, and force enough to expel, the fetus.

The nervous system is in a high state of irritation, as may be concluded from the headache, toothache, neuralgia, vertigo, and longings and aversions so common in the pregnant condition. Parturient and puerperal women are highly emotional. The presence of a disliked or dreaded person in the lying-in room may arrest labor-pains. A letter containing unpleasant news may cause a rise of several degrees in temperature. Shame in those who have "loved not wisely, but too well," fear of destitution in the poor, indignation at a husband's cruelty, are all factors that lower the vitality and diminish the power of resistance. Since every muscular contraction and all secretory functions are controlled by nervous action, we can imagine that even the propagation of microbes, their distribution in the body, and their expulsion from it may be influenced by the condition of the nervous system.

At the end of labor the patient is exhausted by pain and loss of blood, and the genital canal is full of tears and abrasions, which open for microbes free access to the tissues. If this is true of even the most normal delivery, it applies with still greater force to tedious deliveries and to those in which the accoucheur must resort to operative interference, necessitating the introduction of fingers, hands, or instruments into the genital canal.

Normally, the muscular tissue should contract forcibly during the expulsion of the child, and should remain contracted until all veins on the placental site are closed by simple agglutination. But if the muscular contractions are defective, the woman may either bleed to death, or the veins may be plugged up by the formation of clots, which are an excellent soil for streptococci and staphylococci, and into the depths of which they therefore rapidly penetrate.

The separation of mother and child outside the placental site, which separation ought to take place between the superficial and the deep layer of the decidua, may be defective, so that larger or smaller pieces of membranes are left behind, and at the placental site a cotyledon may be torn off and remain in the uterus. Such remnants of the secundines soon become covered with saprophytes, and they undergo a putrefaction which may lead to more or less serious consequences. The entirely normal lochial discharge is in itself an excellent medium for the cultivation of all sorts of microbes.

After the birth of the child a retrograde process begins. The hyperplastic and hypertrophic tissues have to be liquefied and be reabsorbed, the inter-

mediate stage being fatty degeneration. While before delivery there is a strong current of plastic material toward the uterus and the child, after delivery the direction is reversed, and a strong current carries effete material from the genitals, especially the uterus, to the rest of the body.

Primiparæ are still more exposed to infection than those who have before borne children, labor being longer, the canal to be traversed being narrower, and the parts composing it being softer.

Delivery in general hospitals exposes the patients to greater dangers than delivery in special lying-in institutions or in their own homes. Parturient women ought not to be in the same room with puerperæ, the discharges from the latter being particularly dangerous to the former. The crowding of too many puerperæ into one room is in itself dangerous. The less the space the greater becomes the difficulty of obtaining absolute cleanliness, and the greater is the danger of noxious substances being carried from one patient to another.

The exciting cause of puerperal infection is, as we have seen, the introduction of certain microbes into the body of the woman, as a rule into her genital tract.

Sources of the Poison.—The infection may come from a woman similarly affected, from suppurating or decaying tissues, from putrefying substances within or without the body, and from zymotic diseases, especially erysipelas and diphtheria.

Contagion.—That the disease may be brought from one patient to another was discovered by British physicians, and, while in America it was denied by the leading obstetricians of the day, Hodge and Meigs, nevertheless it was proved to be contagious by the masterly essay of Oliver Wendell Holmes, who so distinguished himself in another line that his merit as a physician is apt to be overlooked.¹⁰

Now-a-days the contagiousness of puerperal infection is universally admitted, and the only mooted point is whether it is essential that the microbes be carried from one patient to another on solid objects or whether they may float through the air—a point to which we shall presently return.

Suppuration.—That the source of puerperal infection may be suppuration was pointed out as early as 1847 by Semmelweis.¹¹ Students who had examined a patient with a cancerous ulcer of the uterus caused puerperal fever in and death to fourteen women.

In America was the celebrated case of Dr. Rutter of Philadelphia, who in 1843 had forty-three cases of puerperal septicemia in his practice, while neighboring practitioners had none. He bathed, changed his clothes, shaved off his hair and wore a wig, stayed ten days away from the city, and did not take with him to his next patient anything he had before worn or carried. She had an easy confinement, yet she died from puerperal fever. The great Meigs taught his students that such a fatality was God's providence.¹² It remained for the present generation to find the solution of the riddle in the fact revealed by a contemporary of Dr. Rutter, that he suffered from an obstinate muco-purulent coryza.¹³ It is easy to understand now how by

touching his nose with his fingers Dr. Rutter brought staphylococci and streptococci into the vagina or the uterus of his unfortunate patients.

A French physician who had delivered eight hundred women without accident was seized with suppurative adenitis, for which he wore a drainage-tube. Within three weeks he had three cases of puerperal septicemia.¹⁴ During the time of the great morbidity and mortality in the New York Maternity Hospital immediately preceding the new era an assistant suffered frequently from pustulous eczema of the hands. A dentist, Dr. Pedley, called attention to decayed teeth in doctors and nurses as a possible source of puerperal infection.¹⁵

In 1889 there was in the New York Maternity Hospital a paralytic patient having a carbuncle in the sacral region. There were two puerperæ in the same ward, and all were in the hands of the same nurse. One of the two puerperæ, who had been perfectly well up to the eighth day after her confinement, got a chill and her temperature rose to 105.6° F. On the cervix was found a diphtheritic infiltration. The patient with the carbuncle had no puerperal affection of any kind.

Putrefaction.—Semmelweis showed conclusively that the enormous mortality prevalent in the lying-in hospital of Vienna was due to cadaver-poison brought by the students from the dissecting-room to the wards in which women were examined and delivered. The hospital has two departments, one for students and one for midwives, admission taking place to each department on alternate days. Nevertheless, the mortality in the students' department was three times higher than that in the midwives' department. A similar instance is reported from private practice. A Scotch physician, Dr. Renton, and a friend practised in the same place. During a so-called "epidemic" of puerperal fever all Renton's patients remained healthy, while all those of his friend were taken sick. The difference between the two was owing to the fact that Renton did not, while his friend did, perform autopsies.¹⁶

The infection may originate also from a decomposing part of a living body. Thus, frequently pieces of placenta or of membranes, left behind in the uterus, become the starting-point of puerperal infection. The writer once had a patient who gave birth to a macerated fetus, and from whose uterus a decomposed placenta was removed without doing the least harm to the parturient, but it gave rise in another patient to one of the worst cases of puerperal infection in the writer's experience. The assistant who delivered the first woman was allowed by his colleague in charge of the second to examine her, and, although he disinfected his hands with bichlorid, he doubtless brought on his fingers the germs that came near costing the woman her life.

Some years prior to the date of the writer's connection with the New York Maternity Hospital there was erected on Blackwell's Island, N. Y., a new building designed as a maternity hospital. The building had scarcely been opened before such a so-called "epidemic" of puerperal fever broke out in it

that it had to be vacated. The cause of this epidemic was probably due to the guano with which the surrounding grounds had been covered in order to make a garden.

Fehling¹⁷ observed an epidemic of puerperal fever, diphtheria, and erysipelas as the consequence of a bursted waste-pipe, the dirty water soaking into the ground on which stood the hospital.

Gustav Braun¹⁸ in 1889 had so serious an epidemic in the Vienna lying-in hospital that during one month nearly 18 per cent. of the puerperæ were taken sick, and nearly 9 per cent. died. He attributed the trouble to the fecal matter from the hospital and that of a neighboring barrack being evacuated into a canal flowing past the hospital.

The immediate contiguity of a churchyard, a dunghill, a privy, a stable, a slaughter-house, a cess-pool, a sewer, a pool of dirty stagnant water, or similar places where organic substances are undergoing decomposition, is therefore dangerous to a parturient woman.

Zymotic Diseases.—The exact relations between puerperal infection and zymotic diseases are not definitely settled. Since it is now known that it is the same streptococcus which gives rise to both diseases, there can hardly longer be entertained any doubt of the possibility of puerperal infection being due to the poison brought from a person affected with erysipelas to a puerpera. The same observation applies probably to diphtheria, since a diphtheritic local affection entirely like that which occasionally develops in a wound, and which commonly appears in the upper air-passages in diphtheria, is one of the commonest forms of puerperal infection.

Scarlet fever may attack a puerpera, but it remains scarlet fever and follows a similar course to that in other patients. Typhoid fever is so well characterized by the intestinal ulcers, and is so different from puerperal infection, that the two must be distinct diseases, but this fact does not prevent one disease from leading to the other.

Ways by which the Poison enters the Body.—In the vast majority of cases the poison causing puerperal infection is brought mechanically into the genital tract by the fingers or by the instruments of doctors, midwives, or nurses. It may lurk in a lubricant or may adhere to a sponge, a rag, or to any other substance coming in contact with the genitals.

Many think that this mode of entrance is the only one, and deny infection through the air—a view which, in the writer's opinion, is contrary to many well-authenticated facts. There have already been quoted on the preceding page instances where epidemics in hospitals could only be traced to the ground, the walls of a building, or the air near it being infected by fecal matter and other refuse. Now, it does not seem at all likely that the doctors and nurses brought the microbes from the guano lying on the ground outside the new hospital on Blackwell's Island referred to, nor from the feces floating in the canal flowing past the Vienna hospital, nor from the wet ground that was soaked by the bursted waste-pipe described by Fehling. It is certainly more probable that the streptococci were carried through the air into the hospitals

and were deposited on clothing, instruments, dressing-materials, or even on the hands of the physicians and nurses.

Some years ago there was in the New York Infant Asylum a local epidemic of puerperal infection, the cause of which was found to be a dead rat in the cellar. The doctors and nurses never visited the cellar, and the fireman who attended to the furnace there never entered the wards. Is it not, then, a logical conclusion that the microbes developed in the dead body of the rat were carried by the air of the cellar from floor to floor through the whole building? This method of dissemination is so much the more likely, inasmuch as we have exact observations showing the existence of the streptococci in the air. Bumm¹⁹ found the cocci in the dust floating in the air.

Depaul²⁰ reported the case of a pupil-midwife who, while washing the genitals of a patient affected with puerperal fever, felt an unpleasant sensation, was taken sick in the evening, and died on the third day "with all the symptoms of the most characteristic puerperal fever." The diagnosis of puerperal fever was confirmed by the autopsy; she was found also to be a virgin and not menstruating. The natural inference is that she inhaled through the lungs the poison that caused her death. Credé²¹ has shown that puerperal infection in children may start from the mouth.

The theory of air-infection in a limited space is also borne out by the effect of sanitary measures. Before the present system of antiseptic midwifery in the New York Maternity Hospital was practised, patients were always free from fever during the first week after a ward had been fumigated with sulphur. Busch²² found that he prevented puerperal fever in the Berlin lying-in hospital by heating the wards before using them to 60° Réaumur (= 167° F.). In many hospitals a great improvement was obtained in the rate of mortality simply by introducing a better system of ventilation.

The writer firmly believes, therefore, in the possibility of the transmission of the morbid agent in puerperal infection through the air, but this applies only to closed rooms or to short distances. The atmosphere in general is not contaminated, and epidemics, in the old sense of the word, do not exist. They can always be traced to an individual carrier or to the neighborhood of a focus from which the disease spreads.

Autoinfection.—Some divide puerperal infection, in regard to its origin, into two classes, called *auto-genetic* and *hetero-genetic*. In the first class the puerpera is supposed to infect herself; in the second the infection is brought to her from without. According to some of the most modern bacteriologists, autoinfection is only possible as sapremia.²³ They maintain that the pathogenic cocci are never found in the healthy vagina nor in the healthy cervix.²⁴ Döderlein thinks that streptococci brought into the vagina soon disappear, just as he proved it experimentally for staphylococci. But other authorities²⁵ claim to have found both streptococci and staphylococci in the vagina of healthy pregnant and puerperal women. When we take into consideration that at least staphylococcus pyogenes abounds on human hands,²⁶ it can hardly be doubted that it is found also on the skin of the penis. Since, now, women

often have sexual intercourse up to the day of their confinement, there is no difficulty in supposing that they have, at the time of their confinement, such cocci in the vagina, and that, in a certain sense, they may infect themselves, not only with saprophytes, but also with pathogenic cocci. Furthermore, puerperal infection may be due to diseased uterine appendages, or since a woman always has numerous saprophytes, and sometimes pathogenic cocci, in her vagina, these organisms may be carried hence by a perfectly disinfected finger into the uterus and cause infection, which in a certain sense is also an autoinfection.

We must also remember that few vaginæ are absolutely healthy. It is claimed²⁷ that normal vaginal secretion contains only *Bacillus vaginalis* and *Cidium albicans*, but as soon as the secretion becomes alkaline—which it easily does by admixture of cervical secretion—saprophytes, pyogenic staphylococci, and streptococci find a favorable soil, and autoinfection becomes possible.

Time of Infection.—Infection commonly takes place during delivery, but it may occur both before and after.

MORTALITY.—Puerperal infection is one of the most important of diseases. Before the introduction of antiseptic treatment puerperal infection often prevailed in so-called "epidemics," of which, according to Fordyce Barker,²⁸ more than two hundred had been described since 1740; independently of such periods of a conglomeration of fatalities the number of those carried off by the disease was and is very large. In the magnificent Lariboisière Hospital in Paris the mortality used to be almost 8 per cent. of all the women delivered.²⁹ In one of the services of the large lying-in hospital in Vienna the mortality for six years (1841–46) was almost 10 per cent.³⁰ In the Maternity Hospital of Paris it averaged during five years (1860–64) 11 per cent.³¹ During seventeen years (1861–77) there was in Berlin one death from "puerperal fever" in every 178 confinements, or 0.57 per cent., and a total mortality in childbed of 1 in 152, or 0.65 per cent. Outside the capital the mortality was much greater. In all Prussia there died during sixty years (1816–75) 0.8 per cent. of all confined women, or, more exactly, 8322 out of every 1,000,000.³²

Influence of Antisepsis on Mortality.—The above very important and convincing statistical researches have been continued, and they show an improvement, which generally is attributed to the obligatory use of antiseptic drugs in the management of confinement cases. Thus the puerperal mortality from all causes was in Prussia during the eleven years following 1875 (1876–86) 0.5833 per cent., an improvement of 27.5 per cent.³³ Limiting the investigation to the child-bearing age (fifteen to forty-five), the mortality from "puerperal fever" was in the first period (1816–75) 12.01 per cent., and in the second (1876–86) 9.97 per cent., an improvement of 16.9 per cent.

Similar investigations in Denmark lead almost exactly to the same results, both as to the great mortality and to the improvement since the introduction of antiseptic precautions.³⁴ Still, with the sole exception of tuberculosis, "puerperal fever" is the most fatal disease for women between fifteen and

forty-five years of age, and if we take the period of ten years between twenty-five and thirty-five years of age, in which most children are born, one death in every six is due to "puerperal fever." In the grand-duchy of Baden, however, the puerperal mortality has remained the same during the last forty years—a circumstance which is accounted for by the inefficiency of the midwives, who do as much harm as good by their way of using antiseptics.³⁵

PATHOLOGY.—A peculiar feature of puerperal infection is the great diversity of the pathological changes—a circumstance that has given rise to much perplexity, but which can easily be accounted for, since it is known that the true agents at work are living organisms or a poison produced by them.

Vulvitis and Vaginitis.—The external genitals may be the seat of a *catarrhal* or of a *diphtheritic* inflammation. In the catarrhal form the mucous membrane is swollen and red, and it secretes a muco-purulent fluid. In the diphtheritic form small whitish or yellowish false membranes appear, spread, and join one another until there is formed a more or less thick and large patch intimately connected with the surrounding tissue, which is swollen, infiltrated with serum, and of a dirty greenish or a brownish color.

Endometritis.—The endometrium is the chief point from which infection spreads throughout the body. The endometrium may be the seat of a catarrhal inflammation, when it is red, swollen, covered with a purulent fluid, and sometimes studded with small round pustules. The lips of the os are swollen and covered with granulations that easily bleed. Other forms of endometritis soon implicate the deeper layers of the uterus, and need no special description apart from that to be given under *Metritis*.

Metritis.—Metritis may assume four different forms—the simple, the diphtheritic, the dissecting, and the putrescent.

Simple Metritis.—In the simple form the uterus is much enlarged, its walls are thick, the tissue is soft and friable, and near the inner surface almost diffuent, cherry-colored, and bathed in a dirty greenish-brown fluid. The cervix is often torn or bruised.

Diphtheritic metritis is characterized by a condition similar to that just described in the external genitals. As a rule, the process begins in the cervix. It may, however, begin also at the uterine ostium of the tube, and spread through the wall as a yellow layer out to the peritoneal coat of the uterus.

Dissecting metritis (Fig. 419) is a form that has been little heeded.* In this form a large piece of the muscular tissue of the uterus is severed from its surroundings, and is expelled sometimes so long as seven weeks after confinement.

Putrescent Metritis.—In the putrescent form the walls of the uterus are so

* The writer has personally observed and described eight cases. He has given the affection its name, and was the first to point out its relation to the puerperal state (*New York Medical Journal*, 1882, vol. xxxvi. p. 587; *Archives of Medicine*, April, 1883; *Medical Record*, Dec., 1883, vol. xxiv. p. 664). A few cases have been added in Germany (see Hoechstentbach, *Archiv für Gynäkologie*, vol. xxxvii. p. 175).

thin that they show impressions of the intestine. The uterus is large. The mucous membrane of the interior hangs in discolored shreds, or it is easily movable over the subjacent tissue. The submucous connective tissue may be changed to a whitish mass, and the muscular tissue may be red and flabby; but sometimes the destruction extends deep into the muscular tissue, forming irregular cavities filled with a chocolate-colored or a black pulp, or with a more ichorous or purulent fluid. It is particularly the placental site which is affected by this deep burrowing, the pathogenic microbes finding a favorable soil in the thrombi closing the veins. In other cases the infection follows the lymphatic vessels.

Salpingitis.—The Fallopian tubes are more rarely the road followed by the infecting microbes, but we may have both catarrhal and diphtheritic inflammation extending from the endometrium to this locality.

Oöphoritis.—The ovaries very frequently are affected. We may find a superficial inflammation, the so-called *peri-oöphoritis*, combined with peritonitis, or *parenchymatous* oöphoritis, in which the deeper parts are inflamed, and which may end as an *ovarian abscess*.

Cellulitis.—The connective tissue of the pelvis and adjacent parts of the abdominal wall may be swollen, be infiltrated with serous fluid, and be the seat of hemorrhagic thrombi. This inflammation may end in resolution or in suppuration, the abscess opening into the rectum, the vagina, and the bladder, or breaking through the skin, often after long wanderings, especially at Poupart's ligament or above the crest of the ilium.

Lymphangitis.—The lymphatic spaces and vessels are the chief roads by which puerperal infection reaches the deeper parts. Those of the vulva and the lower fourth of the vagina lead to the superficial inguinal glands, from which others go to the deep inguinal glands, which again are in connection with the external iliac glands. Thus a neglected wound on the labium may become the starting-point of a general peritonitis.

From the upper three-fourths of the vagina and the cervix the lymphatics go to the internal iliac and the sacral glands. The uterus itself is a network of lymph-spaces and lymph-vessels, which finally lead to the lumbar glands (Fig. 420). While the lymph-vessels, normally, are so small as to be invisible when not injected, in puerperal lymphangitis they become as thick as a goose-quill, and they may form prominences on the surface of the uterus as large as cherries and filled with a purulent fluid. From the finer lymph-vessels the infection extends to the surrounding connective tissue.

Peritonitis.—Peritonitis is the commonest affection in the graver cases of puerperal infection. The abdomen is swollen, the intestines being distended with gases. The inflammation may be *local*—that is, limited to the pelvis—



FIG. 419.—Dissecting metritis (Garrigues): specimen expelled by B. R.— at the New York Maternity Hospital on Oct. 20, 1883, the twenty-sixth day after confinement. This was the eighth case of the report published in the *New York Medical Record*, vol. xxiv. p. 661. (The figure, taken from a photograph, is two-thirds natural size.)

or be *general*, extending over the whole abdomen; or it may be *adhesive* or be *purulent*. The peritoneum is injected; its epithelium is thrown off, and it is in places covered with plastic lymph, which binds the knuckles of the intestines together or to the other pelvic and abdominal organs. In the peritoneal cavity

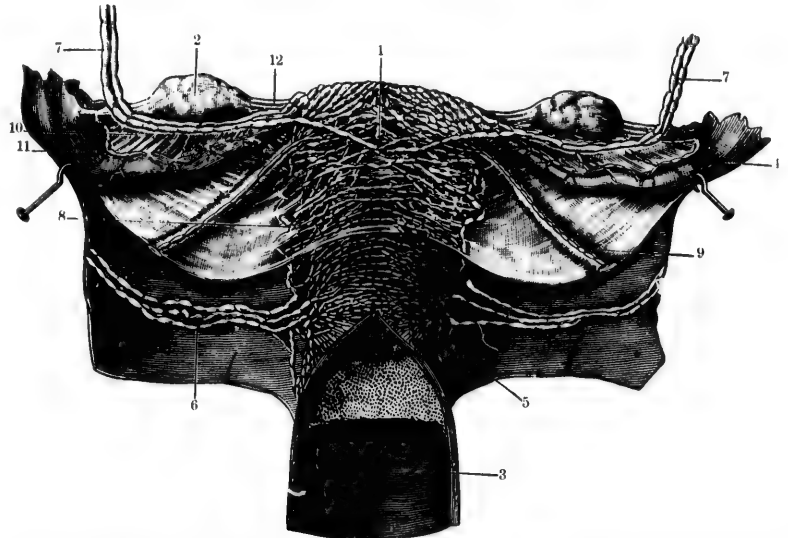


FIG. 420.—Lymphatics of the uterus: 1, lymphatics from the body and fundus of the uterus; 2, ovary; 3, vagina; 4, Fallopian tube; 5, lymphatics from the cervix; 6, lymphatic vessels from the cervix going to the iliac ganglia; 7, lymphatic vessels from the body and fundus going to the lumbar ganglia; 8, anastomoses of cervical and uterine vessels; 9, small lymphatic vessel in the round ligament going to the inguinal glands; 10, 11, lymphatic vessels of the tubes which empty into the large lymphatic vessels from the body of the uterus; 12, ovarian ligament (Poirier).

is found a fluid that may be serous, fibrinous, or purulent. Often this fluid very much resembles milk, and contains large clots like curdled milk. The inflammation starts in most cases from the endometrium and spreads through the lymphatics.

Pleurisy and Pericarditis.—From the peritoneum the microbes find easy access, through the stomata of the diaphragm, into the lymphatics of the pleura and the pericardium, which become red, swollen, and injected, are covered with false membranes, and contain a sero-purulent fluid.

Phlebitis.—The veins also often offer, as has been noted, roads for the microbes to enter the system, although less frequently than do the lymph-vessels. Phlebitis occurs in the uterus or in the lower extremity.

Uterine Phlebitis.—As we have stated, the thrombi (Fig. 421) that form in the uterine sinuses, where the contraction and retraction are imperfect, are a fertile soil for pathogenic germs. From the sinuses of the uterus the thrombosis may extend more or less into the uterine and other veins. The thrombus may become tunnelled, so that the vessel regains its lumen, or it may become organized into connective tissue and form a permanent plug. A piece of the

adhesive or be
torn off, and it is
of the intestines
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of the uterus; 2, ovary;
from the cervix going
to the ovaries; 7, am-
bar ganglia; 8, am-
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thrombus may be torn off and be carried far away by the blood-current, forming an embolus, or the thrombus may become disintegrated and be liquefied to a puriform fluid which mixes with the blood and causes the condition known as *pyemia*. In this way the microbes may be carried throughout the body, forming new foci of disease in all organs. Thus infarctions appear in the lungs and lead to pneumonia and to pulmonary abscesses. The posterior part of the lungs is often the seat of hypostatic pneumonia. The spleen, which is large and soft, may contain infarctions, but these rarely suppurate.

The kidneys are the seat of hyperemia and infarctions, the latter often forming abscesses. In cases with a more chronic course amyloid degeneration may set in. Sometimes the loose connective tissue around the kidneys is inflamed, and there may form a perinephritic abscess. The liver may become the seat of hepatitis and hepatic abscesses. The mucous membrane of the intestines is swollen, but no ulcers form. The heart is frequently affected by endocarditis, often of the ulcerous variety, by myocarditis, or by pericarditis.

The eyes may be destroyed. The brain and its meninges are rarely inflamed. The breasts, the parotid, the tonsil, and the thyroid body may become inflamed and suppurate. On the skin appear erythematous, erysipelatos, vesicular, or pustular eruptions. The articulations are often affected, and they may fall a prey to pyarthrosis, ending in ankylosis. The subcutaneous and intermuscular connective tissue may be infiltrated extensively with pus, and form large shreds of mortified tissue.

Phlebitis of the Leg.—The disease known as *phlegmasia alba dolens* may be due either to phlebitis or to cellulitis. Often both conditions are combined. The phlebitis may begin primarily in the leg, or it may come on as a secondary affection after the iliac and ovarian veins have become inflamed. In some cases the inflammation of the vein may be secondary to thrombosis, and may again lead to periphlebitis and cellulitis. In other cases the process takes an inverse course, the inflammation of the connective tissue leading to phlebitis and thrombosis. The thrombi are subject to the same changes as stated above. In the phlebitic form one or more veins form solid strings, and below the obstruction the extremity becomes edematous and swollen. In the cellulitic form the skin is white or pink, tense, and hard; one or both legs swell, and the epidermis may be lifted by a serous fluid, forming large vesicles. The inguinal glands swell. Suppuration and mortification may spread destruction in the connective tissue under the skin or between the muscles. This pernicious form, however, is rare.

Acutest Septicemia.—In the severest cases of puerperal infection the above-mentioned inflammations hardly find time to develop before the patient



FIG. 421.—Clots in sinuses of uterine walls (from specimen in the Army Medical Museum, Washington, D. C.).

succumbs. Still, there are traces of lymphangitis or phlebitis of the uterus, swelling of the connective tissue, and a little bloody fluid in different cavities; the glandular organs of the abdomen are large, soft, and friable, the microscope showing their cells to be in the condition called "cloudy swelling;" the blood is dark, thin, and only slightly coagulable.

SYMPTOMS, DIAGNOSIS, AND PROGNOSIS.—In treating a case of puerperal infection one would first like to know if he has to deal with pathogenic or with non-pathogenic bacteria. In some particularly well-appointed clinics an expert bacteriologist makes daily microscopical examinations and pure cultures, but most physicians have to form an opinion by the phenomena observed in the patient herself. In this respect three points are of great importance, namely: If the infection is caused by pathogenic microbes, the disease begins earlier, perhaps within a few hours after delivery, and certainly within a few days; the general condition of the patient suffers much more, and she soon becomes somnolent; and, finally, the frequent, weak pulse and the high temperature bear witness to the presence of higher fever. But even an infection that begins as non-pathogenic, or a condition that originally is not caused by infection at all—for instance, a marantic thrombosis—may later change in character and end in sepsis.

Some groups of cases are so well marked in many respects that it facilitates the description to point them out. Thus there are *localized* cases, where the disturbances are limited to the genital canal and hardly affect the system in general. There is a *lymphatic* form, in which the invasion takes place through the lymph-vessels, and which begins early and implicates the serous membranes, causing peritonitis, pleurisy, and pericarditis. There is a *phlebotic* form, in which the microbes enter through the thrombi in the uterine sinuses. The latter form begins later, progresses more slowly than the preceding form, and it is characterized by repeated chills and metastases in remote organs. Finally, there are cases of *acute septicemia*, in which the patient succumbs before the usual inflammations are well developed. But all cases cannot be divided into these groups: sometimes two forms are combined, such as lymphangitis and phlebitis; and often one passes into the other, as when an affection seemingly local in the course of its development ends by becoming generalized. The writer prefers, therefore, to follow the anatomical distribution, and to describe the symptoms observed in each organ, adding remarks in regard to diagnosis and prognosis as he progresses from one to another.

Vulvitis and Vaginitis.—*Symptoms.*—In the *catarrhal* form of vulvitis and vaginitis smarting occurs during micturition.

The *ulcerative* form is accompanied by slight rise in temperature, the labia being swollen and tender, and the ulcers being slow to heal, the process of reparation requiring so long as three weeks. The lochia are often fetid; the patient complains of smarting when she urinates, and sometimes she suffers from retention of urine.

The *diphtheritic* form is much more serious. It begins often with a chill, followed by high temperature, which may reach 107° F. This fever

begins generally from two to four days after delivery. It has no typical temperature-curve, except that there is a rise every evening. The pulse is rapid and weak, and the respiration is accelerated. The patient has no appetite, the tongue is coated, the bowels are often loose, and she is frequently troubled with nausea and vomiting.

As a rule, the uterus is implicated. It is large and tender, and the lochia become scanty, grayish, and offensive. The secretion of milk does not begin or the secretion ceases. The patient complains of pain in the hypogastric region, sometimes extending down to the legs. She has severe headache, and soon becomes stupid and delirious. These signs of general affection may precede the appearance of the diphtheritic exudation. For several days new patches form and the old ulcers spread. From the time the infiltration ceases until the scabs produced by the treatment recommended below are cast off and the sores healed about a week elapses. The labia are swollen and are covered with the above-described patches. Erythema or erysipelas may start from them and spread more or less over the body. Sometimes the tissues become gangrenous. Cicatrices may cause considerable shortening and narrowing of the vagina.

Diagnosis.—With a little care diphtheritic ulcers cannot be confounded with pus-covered tears in healthy tissue. These tears give rise to no general or local disturbance.

Prognosis.—In the catarrhal and ulcerative forms of vulvitis the prognosis is good. The diphtheritic form, however, shows considerable mortality.*

Endometritis and Metritis.—*Symptoms.*—The *simple* form of metritis is characterized by moderate fever, often beginning with a chilly sensation; some pain, especially severe after-pains; headache, anorexia and a coated tongue. The lochial discharge is fetid, continues red longer than usual, or becomes so again after having been yellow. The uterus is enlarged and tender. In regard to the *diphtheritic* form the reader is referred to what has been said above under *Vulvitis*. *Dissecting* metritis (Fig. 419) gives rise, as a rule, to a protracted purulent discharge. The *putrescent* form shows symptoms similar to those found in the most severe diphtheritic cases, and it is accompanied by a particularly offensive discharge.

Prognosis.—In the simple form of metritis the prognosis is good. The disease lasts a week or two. In the diphtheritic form the prognosis is doubtful, the disease often ending fatally. The dissecting form has a better prognosis.† The putrescent form is nearly always fatal.

Salpingitis and Oöphoritis.—These affections appear only together with endometritis or peritonitis, and their symptoms are merged in those of the inflammation of the uterus or of the peritoneum.

Cellulitis, or Parametritis.—The inflammation of the pelvic connective tissue in general begins with a chill or a chilly sensation, followed by fever,

* Of 27 cases of puerperal diphtheria, forming the base of a paper³⁶ by the writer, five died.

† Of 14 cases known, three ended fatally. Of the writer's 8 cases only one died, which death was due to rupture of the uterus in consequence of an error committed by an assistant.

anorexia, weakness, and headache. The temperature rises, the pulse and the respiration become more frequent, the patient complains of pain at the side of the uterus, and by bimanual examination we find the fornix of the vagina tender and a swelling extending from it in the direction of the iliac fossa. When the swelling increases, it pushes the uterus over to the opposite side. As a rule, only one side is affected, but sometimes a similar condition is found on both sides. The uterus is hardly movable. Severe neuralgic pains may extend down the lower extremities or up to the lumbar region, which condition may be due to simple pressure on the nerve-trunks in the pelvis or to an implication of the nerves in the inflammation. If the inflammation attacks the connective tissue of the iliac fossa, the corresponding extremity is drawn up and adducted, so that the affected knee rests on the other extremity. The extremity swells and becomes edematous. Sometimes thrombi may be felt in the veins of Scarpa's triangle, of the popliteal space, or of the calf.

Usually the inflammation ends in resolution. If pus forms, the patient has repeated chills, the swelling becomes softer, and, finally, fluctuation may be felt. The pus may be evacuated through one of the hollow organs—vagina, rectum, or bladder—or may break through the skin in more or less remote places, especially near Poupart's ligament or at the crest of the ilium. The abscess may now close, but often suppuration goes on, especially if the abscess-cavity communicates with the intestine, and, finally, the patient may die from exhaustion. In very rare cases the abscess ruptures into the peritoneal cavity, causing general and speedily fatal peritonitis.

Diagnosis.—It may be difficult to decide whether an exudation begins in the connective tissue or in the peritoneal cavity. Cellulitis nearly always starts from a torn cervix. The swelling is found on the side of the uterus, not behind, or, if so found, then only as a comparatively thin projection or bridge. When it reaches the pelvic wall it follows the latter closely, while in peritonitis the fingers may be inserted between the swelling and the bones. If the inflammation spreads in cellulitis, it often goes down on the side of the vagina to the vulva; a peritonitic exudation can only increase in the direction of the other side or upward, and it implicates, as a rule, Douglas's pouch, pushing the uterus forward.

Prognosis.—As a rule, the prognosis is good. Generally, the process ends in resolution within two weeks. But it may be very protracted, even without suppuration. If an abscess is formed, the prognosis as to life and duration is less good, but even then with proper treatment the patient generally recovers. Rupture into the peritoneal cavity is fatal, unless laparotomy is performed. If cellulitis appears as part of the general infection, the result is very doubtful.

Lymphangitis.—Lymphangitis may start from the vulva and the lower part of the vagina or from the uterus.

Vulvar lymphangitis is of little importance if it is arrested at the superficial inguinal glands. The patient presents the usual fever-symptoms, and red lines may be seen on the skin extending from the vulva to the groin. The

labia swell and smart. The glands very rarely suppurate. If the inflammation implicates the deeper inguinal glands, it may lead to peritonitis.

Uterine lymphangitis (Fig. 420) is the most common beginning of general puerperal infection, but it may also continue as a local process. The patient shows the usual fever-symptoms. The uterus is enlarged and tender, especially near the cornua. The pulse is full. There may be a little vomiting and some tympanitis.

Diagnosis.—Uterine lymphangitis differs from cellulitis and local peritonitis in the absence of swelling at the vaginal roof; from general peritonitis in the limitation to the lower part of the abdomen, the full pulse, and the absence of green vomit.

Peritonitis.—On account of the difference in the severity of the symptoms and the prognosis it is expedient to consider *local* and *general* peritonitis separately.

Local peritonitis, like the other localizations hitherto described, begins with a chill, but this is much more protracted, lasting from ten to twenty minutes, and it is accompanied or is followed by a peculiarly intense pain in the lower part of the abdomen, which is extremely tender to the touch. The temperature rises suddenly to 103° or 104° F. The pulse beats from 100 to 120 times per minute, and it is small and hard. The respiration is rapid. The fever is continuous, with an exacerbation toward night. The patient has no appetite, but has an unquenchable thirst. The tongue is coated. The bowels, at first constipated, later become loose. There is usually some vomiting of food, mucus, and bile, and sometimes moderate hiccough. The lower half of the abdomen is distended, and in order to lessen the tension the patient lies on her back and draws up her knees. The secretion of milk is normal or is scant. The lochial discharge is diminished, is of a dirty color, and often is of offensive odor.

In the course of a week or two a distinct tumor is felt in the pelvis and the lower part of the abdomen, which tumor is composed of the uterus, the appendages, the intestine, the omentum,—all matted together with exudation and new-formed adhesions. Below, the exudation is usually situated in Douglas's pouch, pushing the uterus forward, but it may also be placed more laterally, pressing the uterus over to the other side, and at the same time canting it forward. The exudation pushes the fornix of the vagina in front of it, so that the cervix seems to disappear, and together with the corpus uteri it forms a pear-shaped body, without distinction between the two. The abdominal surface of the swelling is uneven, and it offers a different degree of resistance in different parts. Often a peculiar sensation, much like that experienced in pressing a snowball, is felt on slight pressure, due to fresh adhesions being torn, as can be inferred from what we find in laparotomies performed after this crepitation has been felt.

The swelling usually ends in resolution in the course of two or three weeks. Pain, fever, and swelling subside and the patient gradually regains her health. But the swelling may end also in suppuration, in which event

the fever increases; the patient has repeated chills; the swelling softens and becomes boggy, and sometimes fluctuating. If the abscess tends toward the vagina, fluctuation may here be felt. If it progresses to the bladder, the patient feels a frequent desire to empty this organ, and the act of micturition is more or less painful. If the rectum is being implicated, the patient complains of tenesmus. Wherever the abscess breaks a large amount of offensive pus, mixed with grumous masses, is evacuated. The most common, and at the same time the most fortunate, place of evacuation is through the vagina. In some cases after breaking the abscess may close at once, but in other cases, especially if there is a communication with the rectum, it may refill, or, if the pus is found in separate foci, the process of elimination may be very protracted and exhaust the patient's strength. The pus may also follow the vagina downward and open in the ischio-rectal fossa. Enteritis, cystitis, or pyelo-nephritis may develop.

Prognosis.—As a rule, local peritonitis ends in recovery, but it may become general and speedily end the patient's life, or it may take so protracted a course that she succumbs to exhaustion. As to complete restoration to health, the prognosis should be guarded. Peritonitis leaves a predisposition to new attacks. It often causes chronic oöphoritis and salpingitis, making the patient more or less an invalid, and it is a frequent cause of sterility; or, if she again conceives, she is more apt to have trouble in subsequent confinements.

General peritonitis has symptoms similar to those of local peritonitis, but much intensified. It appears, as a rule, from two to four days after delivery, but it may also begin immediately after parturition. The chill lasts from half an hour to several hours. The pain is excruciating, and it spreads over the entire abdomen. The pulse beats from 120 to 160 per minute. The temperature is 104° F. or higher. The respiration ranges from 26 to 56 per minute, and it is shallow on account of the pain produced by the movements of the diaphragm and on account of the compression of the lungs by the inflated intestine. The patient lies on her back, with the knees drawn up. She shuns every movement and dreads every approach. Even the weight of the bed-clothes may be intolerable. Her face expresses the greatest anxiety and pain. Her features are pinched, the corners of her mouth drawn down; the eyes sink deep into their sockets, a black streak showing under each lower lid. The skin is pale; the tongue is dry, red at the point and the edges, and brown in the middle. The thirst is unquenchable. The patient vomits continuously, and the vomit soon has the peculiar appearance of chopped spinach. Commonly the patient has diarrhea, and is often racked by hiccoughs.

The urine, which is scant and often contains albumin, must frequently be drawn with a catheter. The milk-secretion soon ceases. The lochia are scant, often fetid, or disappear altogether. The abdomen is enormously distended; the percussion sound is tympanitic in front, dull at the dependent parts; and the pectoral organs are pushed up and compressed.

The patient often suffers from insomnia, and at the same time, as a rule,

she is in a somnolent condition, is slow to answer questions, or is completely delirious. From her listless lethargy she suddenly starts up as if scared by appalling dreams and visions, and looks around with a pitiful expression of dismay and horror. In some cases the intellect remains clear to the last.

Prognosis.—General peritonitis is one of the most dangerous forms of puerperal infection, but the patient may recover. Favorable signs are the decrease in the frequency of the pulse and the respiration, the fall in temperature, the disappearance of pain, the cessation of tympanitis and vomiting, the return of the appetite, the increase in strength, the return of mental clearness, and a cheerful disposition.

Unfavorable signs are an irregular pulse or one beating more than 140; a temperature above 104° F.; a laborious respiration, over 40; a copious diarrhea; cold, clammy extremities; the appearance of red blotches on the skin; a profuse perspiration; the subsidence of pain, while the distention of the abdomen remains the same or increases. Death occurs usually in nine or ten days, except where an abscess ruptures into the peritoneal cavity, when life becomes extinct in a day or two. What has been said above about the doubtful return to perfect health applies still more to general peritonitis.

Pleurisy.—Pleurisy, as a rule, is secondary to peritonitis or to phlebitis, but it may be a primary lesion. The fluid is sero-purulent, like that in peritonitis, except when it is due to an infected embolus. In such cases the fluid is purulent. When pleurisy supervenes in the course of peritonitis it is easily overlooked—so much more so as, on account of the patient's sufferings, we often cannot make a physical examination. Its advent may be marked by a new chill, by increased fever, and by still more embarrassed respiration.

Prognosis.—Pleurisy is a very serious complication in childbed.

Pneumonia.—Pneumonia appears as hypostatic pneumonia in the most dependent part of the lungs or in disseminated foci due to embolism in any part of the organs. It is generally combined with pleurisy. The usual symptoms of the disease—pain, cough, bloody expectoration, and dyspnea—may be missing, when it can only be diagnosticated by the stethoscopic signs—crepitant râles, bronchial respiration, and dull or flat percussion-sound.

Prognosis.—Pneumonia is a dangerous affection in a puerpera.

Pericarditis.—Pericarditis may be propagated through the lymph-vessels of the diaphragm from peritonitis, or may be due to emboli from a venous thrombus.

The *symptoms* generally become merged into those of other inflammations. Sometimes, however, a friction-sound or an increased dull area reveals the presence of false membranes or of exudation around the heart.

Phlegmasia Alba Dolens.—The *thrombo-phlebitic form* of phlegmasia may begin during pregnancy, and is accompanied by fever and a sensation of heaviness in the limb. Commonly the inflammation begins in the second week after confinement. Sometimes the local affection is preceded by anorexia, a bad taste, a coated tongue, constipation, and eructations. The phlegmasia begins with fever and, perhaps, a chill. The urine is concentrated. If the

thrombosis begins in the leg, the latter swells from the foot upward; but if the leg is secondarily affected after the pelvic veins, the swelling spreads in the opposite direction. The extremity is painful; the skin is white, tense, hard, sometimes covered with blisters, or it may become red and be perforated by an abscess. The affected veins may be felt as hard strings. Both extremities may be affected, the thrombosis passing from one side to the other through the vena cava, or beginning independently in either extremity. The phlegmasia usually runs its course in from three to six weeks, and ends in resolution. It may pass into suppuration and the patient still recover. Sometimes gangrene sets in and leads to death, or septicemia may develop.

Varicose veins are more liable to the formation of thrombi than healthy veins. If the deeper veins are affected, the skin has a peculiar purple color, which variety has been distinguished under the name of *phlegmasia cœrulea dolens*. As a rule, the thrombus is reabsorbed, and the swelling subsides. In other cases there forms a periphlebitic abscess that breaks on the skin; and in still others the thrombus may become infected and give rise to metastases just like those which will presently be described under *Uterine Phlebitis*.

The *cellulitic form* of phlegmasia is characterized by high fever, by considerable pain, by redness of the skin, by the appearance of bullæ, and by extensive suppuration and mortification of the subcutaneous and intramuscular connective tissue. Large shreds of connective tissue may be expelled and the sores heal, but there is great danger of the patient falling a prey to gangrene or to septicemia, or of being exhausted by the protracted suppuration.

Uterine Phlebitis.—The veins of the uterus may be blocked by simple thrombosis, which may extend more or less into the pelvis. If the iliac vein becomes implicated, phlegmasia alba dolens supervenes. If pathogenic microbes find their way into the uterine sinuses, there develops infectious uterine phlebitis—one of the severest forms of puerperal infection.

Uterine phlebitis begins with a long and severe chill, followed by similar attacks at irregular intervals, and it is characterized by metastases in one or more organs. The chills are due to the entrance into the blood of microbes or of their chemical products. During the chills the temperature rises to from 104° to 108° F., the pulse beats from 140 to 160 per minute, the respiration becomes as frequent as from 36 to 56. Rarely the patient, instead of real chills, has only chilly sensations. In the interval between the chills, especially after the first chill, she feels great relief, the temperature sinking to 100° or 101° F., and the pulse and respiration becoming less frequent. In this form of puerperal infection there is no pain, little tenderness, and no tympanitis.

After the lull of the first interval new chills follow, and the more metastases are developed the more the fever becomes continuous. The skin turns yellowish, and sometimes complete jaundice develops. The nose becomes pinched; the eyes lie deep; the cheeks are hollow; the tongue is dry and coated. The patient has no appetite, but has great thirst, headache, insomnia,

sometimes diarrhœa, and less frequently vomiting. Frequently the breath has a peculiarly disagreeable smell, designated as "sweet." The urine is scant, and it almost always contains albumin.

The secondary infection appears first in the lungs, then in the pleura, the heart, the liver, the kidneys, the spleen, the intestine, the meninges, the brain, the eyes, the articulations, the skin, and the connective tissue. Pneumonia, pleurisy, and pericarditis have already been described, and the other localizations will presently be noticed.

Diagnosis.—Uterine phlebitis in the beginning is somewhat like *malarial fever*, but the chills are repeated at irregular intervals and the fever soon becomes continuous. Swollen veins may be felt in the pelvis, and phlegmasia alba dolens may supervene. There is often metrorrhagia. The appearance of metastases is characteristic.

If adynamic and ataxic symptoms develop, the disease may be mistaken for *typhoid fever*. First of all, we must know if the patient is or is not a puerpera. If she denies having recently given birth to a child, it can easily be proved by the presence of milk in the breasts, by the flaccidity of the abdominal wall and the presence on it of purple-colored striæ, by the large size of the uterus, by tears in the cervix, in the vagina, or in the vulva, and by the presence of lochia.

Typhoid fever may develop in the puerperal state, but that is a very rare occurrence. It is characterized by the continuous fever, by ochre-colored stools, by tenderness on pressure in the right iliac fossa, and by the appearance of a few discrete, small pink spots on the abdomen. Visceral complications are rare, and at the end of the third week a decided change takes place for the better or the worse.

In uterine phlebitis there may be gargouillement, but no tenderness, in the right iliac fossa. There may be cutaneous eruptions, but they are spread over larger surfaces as erysipelas, general erythema, large blotches, papules, or petechiæ. There is no regular fever-curve. The disease begins with very high temperature and a pronounced chill. The temperature then falls suddenly nearly to normal, to rise again with the next chill. Complications in different organs are a chief feature of the disease.

The distinction between uterine *lymphangitis* and phlebitis is more of scientific than of practical interest, and frequently the two are combined. Lymphangitis usually begins from two to five days after delivery; phlebitis usually begins at the end of the first week. In lymphangitis there is pain in the lower part of the abdomen; in phlebitis there is hardly any pain. In lymphangitis there is great tenderness on pressure; in phlebitis there is none of the abdomen and little in the pelvis. In lymphangitis the uterus is large; phlebitis has less influence on the involution. Lymphangitis spreads rapidly upward, and may cause peritonitis, pericarditis, pleurisy, hypostatic pneumonia, but it does not affect the head or the limbs nor cause pyæmia with infarction and abscesses in the viscera. Lymphangitis may begin with a chill, but this is not so severe as in phlebitis, and it is not repeated. In lymphangitis

the fever is more continuous; in phlebitis there are very marked fever intermissions or remissions.

Endocarditis.—Endocarditis appears late in the puerperium—from ten to fifteen days after delivery. It is accompanied by an increase in fever and somnolence, and gives rise to a rasping sound, especially at the apex, more rarely at the base. This murmur is generally synchronous with the first heart-sound, but it may also be heard with the second. It shows a peculiar mobility, being heard one day at the apex, the next at the base, or *vice versa*.

Endocarditis is commonly ulcerous. When the small abscesses in the endocardium break, they empty their contents—pus, microbes, and their chemical products—into the blood-current, which carries them through the entire system, causing new localizations of the infection; but the symptoms of these abscesses are so merged into those already present that they cannot be distinguished. The supervention of endocarditis in uterine phlebitis makes the *prognosis* still more unfavorable.

The alimentary canal does not suffer much in uterine phlebitis. We have, however, mentioned the complete anorexia, the unquenchable thirst, the profuse diarrhea, and the occasional vomiting. Sometimes thrush appears on the dry tongue. In rare cases abscesses are formed in the parotid, the tonsil, or the thyroid body, the appearance of which abscesses makes the prognosis more unfavorable.

Hepatitis.—The liver is very frequently implicated in puerperal metrophlebitis. There is pain in the right hypochondrium. The organ is enlarged, as can be found by percussion and palpation, and it is tender on pressure. The skin has a yellow tint, and often real jaundice develops. The serous coat is often implicated in peritonitis, and then sometimes, on slight pressure, there can be felt the crepitation characteristic of new-formed adhesions.

Nephritis.—Inflammation of the kidneys, which is a very frequent occurrence, is characterized by the presence of albumin and casts in the urine, whereas the other symptoms, such as headache, somnolence, disturbed eyesight, vomiting, and pain in the lumbar region, are so covered by the general condition that they lose their diagnostic importance. An inflammation of the loose connective tissue in which the kidney is imbedded may cause constant tenderness on pressure in the lumbar region.

Splenitis.—An inflammation of the spleen may sometimes be diagnosticated by palpation and an increase in the normal dull area in the left hypochondrium. The patient may complain of pain and tenderness in this locality. If an abscess ruptures into the peritoneal cavity, she collapses and dies. Generally the symptoms due to localization in the spleen are, however, so blended with those due to other localizations and the general condition that they are not recognizable.

Nervous Disturbances.—Manifold disturbances occur in the nervous system during the puerperal state, such as neuralgia, paralysis, convulsions, tetanus, tetany, insomnia, delirium, etc., and need not be due to infection, but to anemia or hyperemia of the brain, hysteria, pressure on a nerve-trunk, or a

reflex action. Severe affections of the nervous system may be due, however, to thrombosis of the cerebral veins or to purulent meningitis, produced by metastasis from an infected endometrium.

Arthritis.—Sometimes the infecting agents in metro-phlebitis are carried to the joints. At the beginning many articulations may be affected, but while the inflammation subsides in most of them, it may remain in one or two, especially those of the knee and shoulder. Of the articulations of the trunk, the symphysis pubis, the sacro-iliac, and the sterno-clavicular are most frequently affected.

Puerperal articular inflammation differs from rheumatic inflammation by its stability, and from both this and the gonorrheal type by its pronounced tendency to suppuration. The affected joints become painful, the pain being much increased by movements or by pressure. The skin becomes red and hot, and if there is an abscess in the articulation, the joint may be perforated. All the tissues composing the joint, even the cartilage and bone, may be destroyed. If the patient survives, the affected joint may remain ankylosed.

Abscess and Diffuse Cellulitis of the Limbs.—Both the subcutaneous and the intermuscular connective tissue may become the seat of localization of puerperal infection. The limb swells and is painful. The skin becomes red and hot. Circumscribed abscesses may form, or, especially in the subfascial form, a diffuse phlegmon may extend over a large area—a form which is very dangerous, and which may cost the patient her life or it may leave her in a crippled condition.

Skin Diseases.—A puerpera may, as well as another person, be attacked by eruptive fevers, such as measles, scarlet fever, small-pox, or erysipelas, as an accidental complication. She may likewise have some kind of eruption in consequence of the use of certain drugs—for example, copaiva, quinin salicylic acid, or iodoform.

A *miliary* eruption, consisting of small white vesicles, sometimes each surrounded by a red ring or springing from a red skin, is often found in an otherwise well woman, and is only due to increased perspiration. This eruption is generally found on the trunk. Sometimes an eruption of red maculæ or papulæ, or a general erythema, accompanied by more or less fever, appears on the skin in puerperæ who present no other sign of disease.

But in other cases the skin-eruption accompanies other symptoms of severe puerperal infection, and it must then be regarded as part of the infection. An erythema may spread more or less far from the genitals, or large erythematous blotches may appear on any part of the body. Small dark hyperemic spots of the size of a hempseed—so-called “petechiæ”—that do not vanish on pressure, may appear in very severe, generally fatal, cases. Sometimes there is a pemphigus-like eruption, the epidermis being raised by a serous exudation, forming large vesicles. In other cases, again, bullæ filled with pus develop, rupture, and leave sores.

Finally, infected puerperæ are very liable to have bed-sores, especially on the sacrum and the heels. In all those cutaneous affections that appear as

part of a general infection the symptoms of the latter cover those of the former.

Acutest Septicemia.—This form, the most dangerous of all forms of puerperal infection, has, fortunately, become very rare, and has entirely disappeared from well-conducted lying-in hospitals, institutions where it formerly raged in the so-called "epidemics" of puerperal fever.

It begins soon after delivery with a long and severe chill. The pulse and the respiration are rapid. The temperature in some cases may be high, and may remain so without the remissions characteristic of puerperal phlebitis, but in other cases it is normal or even subnormal. The features are pinched, the skin pale or purplish, and the tongue dry and brown. The patient is in a somnolent, comatose, or delirious condition. She has frequent involuntary, copious, dark, and offensive evacuations from the bowels. The urine is scant, and it contains much albumin. The course of this form is rapid and ends in death in a day or two.

TREATMENT OF PUERPERAL INFECTION.—Puerperal infection being a bacterial disease, its treatment, preventive as well as curative, must chiefly be germicidal. Asepsis and antiseptics are the watchwords in the warfare against it.

It is an interesting historical fact that the great discoveries which form the base of all antiseptic surgery were made by obstetricians long before they were independently made by surgeons, but that the obstetrical discoveries did not succeed in changing the treatment of puerperal disease by other practitioners until the surgeons stirred up the entire world by their wonderful achievements by means of antiseptic measures.

The father of antiseptic midwifery was Semmelweis of Vienna, who as early as 1847 understood that so-called "puerperal fever" was due to infection, and who used chlorin, one of the best germicides, in the shape of chlorinated lime as a disinfectant. But his great discovery remained an uncut diamond, lying despised in a corner, for a whole generation, the discoverer meanwhile dying in a mad-house. It was when the Scotchman Lister, applying the discoveries of the French chemist, Pasteur, to surgery, had laid the foundation of antiseptic surgery (1866), that the Danish obstetrician, Stadfeldt, and the Swiss obstetrician, Bischoff, simultaneously (1870) introduced the use of carbolic acid in midwifery.³⁷

In 1881 the French obstetrician, Tarnier, read a paper before the International Medical Congress assembled in London on his use of bichlorid of mercury as a local remedy for puerperal fever, but no one seems to have paid any attention to it until the German bacteriologist, Robert Koch, published his experiments with this drug, and the German surgeon, Schede, introduced its use in surgery. The bichlorid of mercury, as a preventive and curative agent, was then (in 1883) introduced in many lying-in hospitals. In America it was first introduced in the New York Maternity Hospital by the writer on the 1st day of October, 1883.

While the revolution in the results as to morbidity and mortality from puerperal infection dates from the introduction of bichlorid of mercury, it

has, however, been proved that the true cause of the improved results is not to be sought in the drug, but in its application; that is, the *strict* disinfection of hands, instruments, dressing-material, etc. Some large clinics, such as those of Copenhagen and Vienna, yet cling to the use of carbolic acid,³⁸ and obtain just as good results as those in which this drug has been supplanted by bichlorid of mercury.

If ever a medical fact has been proved by figures, the latter have proved the value of the antiseptic treatment in midwifery. The testimony from over the entire world, independently of geographical position or climatic differences, is unanimous. Counting by thousands, hundreds of thousands, and millions, the figures are too large to be vitiated, the new treatment being now in the eleventh year of its probation.

It would be tiresome and unprofitable to enter deeply into statistics, but the writer can hardly begin the discussion of the treatment of puerperal infectious diseases in a better way than by showing, in a few lines, what the mortality formerly was and what it now is in the institution to which he had the honor of being a visiting obstetric surgeon for a period of over ten years (1881-92), and with which he is yet connected as consulting obstetric surgeon.

The records of the New York Maternity Hospital show the following mortality before and after the introduction of strict antiseptic treatment with bichlorid of mercury:

Year.	Deliveries.	Deaths.	Per cent.
1875	570	15	2.63
1876	536	20	3.73
1877	480	32	6.67
1878	255	7	2.75
1879	254	11	4.33
1880	149	8	5.37
1881	382	9	2.36
1882	431	14	3.25
1883	447	30*	6.71
Total	3504	146	4.17

* All during the first nine months of the year.

During the last six months before the change in treatment was made there were delivered 237 women, nineteen of whom, or 8 per cent., died, and of these seventeen, or 7.17 per cent., succumbed to sepsis. During the last month the total mortality reached even ten out of fifty, or 20 per cent., and that from sepsis 15.69 per cent.

During the first three months after changing the treatment there were 102 deliveries, without a single death—a circumstance which then appeared almost miraculous, but which has become quite a common event, and has later been extended over much longer periods. The following list shows the mortality in the New York Maternity Hospital since the introduction of strict antiseptics:

Year.	Deliveries.	Mortality.		Per cent.	
		Total.	From Sepsis.	Total Mortality.	From Sepsis.
1884	522	8	4	1.53	0.76
1885	537	3	0	0.56	0.0
1886	446	5	1	1.12	0.22
1887	389	5	1	1.30	0.26
1888	377	3	0	0.79	0.0
1889	314	1	0	0.32	0.0
1890	345	4	1	1.13	0.29
1891	240	1	0	0.42	0.0
1892	314	1	0	0.32	0.0
1893	305	2	0	0.66	0.0
Total	3789	33	7	0.87	0.18

Thus, during the last three years, out of 1059 parturient women, only four died, or 0.37 per cent., and not one of them from infection.

By comparing the preceding lists, each comprising nine years, we find a decrease in mortality from 4.17 to 0.87 per cent.; that is, the mortality has been reduced nearly to one-fifth of what it used to be.

In regard to morbidity a similar change has taken place, but the writer has no exact statistical material to offer as proof. He must, therefore, confine himself to an example. During the six months from October 1, 1882, to April 1, 1883, a period for which he has exact notes respecting the whole service, 192 women were delivered, forty-six of whom, or *nearly one out of four, were seriously ill*, and thirty-nine, or nearly one in five, suffered from puerperal inflammation, which now-a-days is looked upon as due to infection. A sick puerpera has now become a rare sight in the wards of the Maternity Hospital.

A certain class of cases is particularly interesting, because all the symptoms of cellulitis—namely, pain, tenderness, and swelling in one of the iliac fossæ—were present, and still there was no rise in temperature—a phenomenon which can be accounted for only in this way: that the condition was due to bruising of the tissues, and that our antiseptic treatment prevented the infection which so easily develops under such circumstances.

Passing to an exposition of the treatment of puerperal infection, we must distinguish between (1) hospital practice and (2) private practice, (3) preventive and curative treatment, and (4) surgical treatment.

1. PREVENTION OF PUERPERAL INFECTION IN HOSPITALS.—Parturient women ought to be provided for in institutions exclusively designed for obstetric purposes, and not in general hospitals. Before the introduction of antiseptics the mortality was much greater in the wards of general hospitals devoted to obstetric cases than in special lying-in asylums; even after the introduction of antiseptic prophylaxis it exposes parturient women to increased risks to be treated by the same doctors and nurses who have charge of the sick.

A lying-in hospital ought to have a free supply of pure air, which ought to circulate freely under the building, whether there be a cellar or the building be erected on pillars. If possible, there ought to be in the wards artificial

Per cent.	
Total mortality.	From Sepsis.
0.53	0.76
0.56	0.0
0.12	0.22
0.30	0.26
0.79	0.0
0.32	0.0
0.13	0.29
0.42	0.0
0.32	0.0
0.66	0.0
0.87	0.18

ventilation, which can only be obtained in the highest degree of perfection by large fans revolving under the building and throwing pure air into the wards. During the season of cold the air is heated before being forced into the wards by the fans.

Where there is no artificial ventilation the windows must be kept more or less open at the top day and night the year round. Although this procedure interferes somewhat with the normal perspiration in childbed, the writer has never observed any harm arise from it in the Maternity Hospital: this immunity probably is due to the habitual exposure of the special class of women there confined, for in private practice the writer has seen coryza, bronchitis, and pneumonia originate from a similar procedure.

The building should preferably be so situated that the patients may get the morning and evening sun; at all events, a northern exposure should be avoided in the temperate zone, and a southern exposure in very hot climates. Even the smallest lying-in hospital should have one or more special rooms for isolating sick patients from the other puerperæ.

There ought to be a regular and rapid rotation in the use of wards. In the Maternity there are nine beds in each ward, and as soon as the last patient has been there nine days the ward is temporarily abandoned and disinfected, the same bed never being used by more than one and the same patient before being thoroughly disinfected. On the ninth day the patient is transferred to the convalescent ward, where she stays until well enough to leave the hospital.

Pregnant women ought to be kept in special waiting wards apart from parturient and puerperal patients. The former often stay for months in the Maternity Hospital, and it is more difficult to keep discipline among them. Pregnant women need other food and regimen; they are less clean and less quiet; they would be exposed to unnecessary anxiety by witnessing the sufferings of the parturient or sick puerperal women; and they might, perhaps, even become infected before their delivery.

The parturient woman ought to be delivered in a special delivery-room, a so-called "pony-room."* As the infection most frequently takes place during parturition, the woman should be delivered in a room where everything is kept strictly aseptic, and by all means not in a room where there are sick puerperæ.

There should be an easy communication between the delivery-room and the wards, so that patients need not be carried far or be exposed to inclement weather; yet there should be no direct communication. In the Maternity Hospital this condition is obtained by having small covered corridors, open on one side, between the delivery-room and the wards.

The wards should likewise be separated from one another. They should have plenty of light, preferably from two opposite sides. Light from above is only needed in an operating-room. All cross-beams and projections should

* The writer believes this singular expression comes from a small bed, a kind of cot, which was called a "pony," and which was used for deliveries in olden times, as it yet is in some countries—for example, Belgium.

be avoided, as they become receptacles for dust, which may become a carrier of germs. The floor and walls should be hard, smooth, and not porous, so that they can easily be kept clean by scrubbing and be disinfected with fluids or with vapors. It is well to have separate rooms provided for patients who have undergone serious operations.

The question of heating is important. It is best to have a combination of different systems. Warm air may be thrown into the wards by fans; steam may circulate in pipes: both these methods ensure a steady supply of heat, and prevent the water from freezing in the supply-pipes in cold weather. Open fires are cheerful; they give a very pleasant radiating heat, contribute to ventilation, and offer an easy way of disposing of small unclean substances, which otherwise may accumulate and vitiate the air in the ward. Stoves combine to some extent the qualities of a radiator and an open fire, and they are more economical. By the evaporation of water the air should be prevented from becoming too dry.

The isolating department should be separated entirely from the common wards, and each patient should exclusively occupy a room. This department should have a special doctor and special nurses, who are not allowed to enter the wards. The physician-in-chief alone should see the whole service.

Water-closets should be of the very best kind, and never be situated in the wards or in the rooms. They should not even communicate directly with the wards or the rooms, but should be separated from them by vestibules with two doors. In the space between the doors a window should constantly be open, and the doors should close automatically.

There should be a place where all linen and bed-clothes used by sick puerperæ can be disinfected by immersion for an hour in bichlorid solution (1:1000) before they are washed; if mattresses are used, there should be a room where they, as well as the blankets, can be fumigated with sulphurous acid by burning sulphur or be disinfected by exposure to superheated steam.

No visitors should be admitted to the wards, as they often come from crowded tenement-houses in which there may be cases of measles, scarlet fever, small-pox, or diphtheria.

The members of the house-staff should not be allowed to enter the wards occupied by other patients, the isolating-rooms, the dead-house, and still less be permitted to make autopsies or to handle anatomical or pathological specimens.

DISINFECTION.—To make the all-important point, disinfection, as clear as possible, the writer will first simply describe how it is carried out in the Maternity Hospital, and postpone for the time being all the mooted points that are being discussed in the medical journals.

The principle upon which the disinfection is based is the belief that puerperal infection is due to bacteria found on the patient, on doctors and nurses, on all surrounding objects, on everything brought in contact with the genitals, and in the air of the room. We will, therefore, have to consider the disinfection of the ward with its furniture, of the patient and of those who minister

to her, of all instruments and materials that come in contact with her, and of the air that reaches her genitals.

Ward Disinfection.—When the last patient has been nine days in a ward it is not used again until thoroughly disinfected. The bed-clothes are taken off the beds, the linens are sent to the laundry, and the blankets are spread over the ends of the bedsteads. All windows and doors are closed. Thirty pounds of sulphur are placed in an iron utensil composed of an upper and lower pan connected by three uprights. The sulphur is put in the upper pan and is moistened with alcohol. The lower pan is filled with water, which would extinguish the fire in case the upper pan was burnt through. After lighting the alcohol the ward is left closed for at least six hours. After that time all doors and windows are opened, and, if the ward is not needed immediately, they are left open for several days. The walls, the floors, and the furniture are scrubbed with soap and water, and thereafter with a solution of bichlorid of mercury (1 : 1000). So long as straw mattresses were used the straw was burned; the patients now lie on woollen blankets spread over a woven-wire mattress.

All bed-clothes used by sick puerperæ are first immersed for an hour in the solution of bichlorid of mercury, and are then preliminarily washed before sending them to the hospital laundry, where they are mixed with the other bed-linen. Patients and nurses wear only such clothes as can be washed. The clothing of the doctors, when required to be disinfected, is suspended in a small room and fumigated with sulphur.

Disinfecting the Patient.—When a patient is taken in labor she is given a full bath of tepid water, being thoroughly scrubbed with soap, and dressed in clean clothes. She is next placed on the delivery-bed on a rubber blanket that has been disinfected with bichlorid (1 : 1000), and the lower half of her body is washed with bichlorid of mercury (1 : 2000), taking particular care to clean every furrow at and near the genitals and the umbilicus. The vagina is irrigated with two quarts of an emulsion of creolin (1 : 100), using metal irrigators. In case bichlorid is used, the irrigators are painted with an incorrodible substance.

Disinfection of the Doctors and Nurses.—The accoucheur takes off his coat, vest, necktie, collar, and cuffs, rolls up the sleeves of his shirt and under-wear to the middle of the arm above the elbow, and covers himself with a large rubber apron reaching from the shoulders to a little above the ankles. He next anoints his hands and arms with soft potassa soap, and scrubs them thoroughly with warm water and a stiff nail-brush, taking particular care to clean the spaces under the nails and at their roots. He then wipes his hands and arms, and scrapes his finger-nails with a steel nail-scraper, and, finally, he scrubs all these parts while holding them for at least three minutes in a solution of bichlorid of mercury (1 : 2000). He is now ready for work, and must not wipe his hands or arms. But, as it is next to impossible to avoid touching different objects from which new disease-germs may be transferred to the hands of the physician, a basin with a warm solution of creolin (1 per cent.) is kept

at the bedside, and with this solution he rinses his hands at the moment before touching the patient. The nurses disinfect themselves with the same care and in the same manner as the doctor.

If the accoucheur has had a patient affected with puerperal infection, erysipelas, scarlet fever, suppuration, or other disease likely to cause puerperal infection, he must take special precautions. If possible, he should stay a quarter of an hour in a full warm bath containing two drachms of bichlorid of mercury, washing the hair and beard carefully while in the water. At all events, he should scrub his hands with greater care than under ordinary circumstances, and should immerse them a longer time, say five minutes, in a stronger solution (1 : 1000), or, what is claimed to be still more efficacious, in alcohol.

Disinfecting the Materials.—All materials coming in contact with the genitals, such as absorbent cotton, lint, etc., are thoroughly soaked in the creolin solution.

Disinfecting the Instruments.—All instruments are disinfected by means of immersion for at least five minutes in a 5 per cent. solution of carbolic acid, or by boiling them in a solution of washing-soda (a tablespoonful to each quart of water), and they are cleaned very carefully after having been used. All instruments composed of several parts are taken apart, the tubular ones being boiled. For axis-traction forceps it is necessary to have a key, so as to be able to take off the traction-rods every time the instrument has been used. Sapolio used with a brush is excellent for scrubbing instruments. No sponges are used. They have been replaced by absorbent cotton, absorbent lint, or sterilized gauze.

Sutures and ligatures are of course carefully disinfected. Silkworm gut stands boiling in water and is kept in alcohol. The writer disinfected catgut by boiling it in alcohol in a closed vessel.* Silk is boiled for half an hour in water, immersed for half an hour in bichlorid (1 : 1000), and is kept in alcohol. If a sterilizer is available, it suffices to expose the silk to the effect of circulating steam for an hour.

Antiseptic Conduct of Labor.—Very few vaginal examinations are made at the Maternity Hospital, and the person making them disinfected his hands immediately before the procedure. In ordinary cases the examining finger should not be brought beyond the external os. We know that pathogenic microbes may be found in the vagina, and even in the cervix, and they are by no means sure to be removed by the preliminary douche. If, therefore, the finger is brought from the vagina into the cervix, or, still worse, into the uterine cavity, it may carry disease-germs into the uterus.

No lubricants are used. The creolin adhering to the finger or the forceps is all that is needed. The only exception made by the writer is when, in the operation of version, the whole hand is introduced into the womb, in which case the dorsal surface of the hand is smeared with mollin containing 5 per

* This method of George R. Fowler has been made easy and economical by the introduction of Charles N. Dowd's condenser. In hospitals it suffices to boil the catgut immediately before the operation in a casserole with cover at the same time instruments are being boiled.

cent. of carbolic acid. In protracted cases the vaginal douche is repeated every three hours.

When the head begins to open the vulva the latter is covered with a piece of lint wrung out of bichlorid solution. This is done partly to prevent the entrance of microbes from the air in the room, and partly because it facilitates all manipulations calculated to protect the perineum by obviating slipperiness. Creolin would, therefore, not be so appropriate for this purpose.

The placenta is removed by *Credé's expression method* (Fig. 204); that is, in ordinary cases not even a finger is introduced into the genital canal after the birth of the child, the placenta being squeezed out by compressing the uterus through the abdominal wall. The writer does not, however, remove the placenta so soon as recommended by Credé, rarely removing it earlier than fifteen minutes after the birth. The membranes should be removed very slowly and cautiously, as they adhere to the inner surface of the uterus; otherwise they would be torn off and remain in the uterus, thus giving rise to puerperal infection.

If on inspection any part of the placenta is missing, the well-disinfected hand of the physician should be introduced into the uterine cavity and the missing part scraped off with the nails. As a rule, the writer does the same

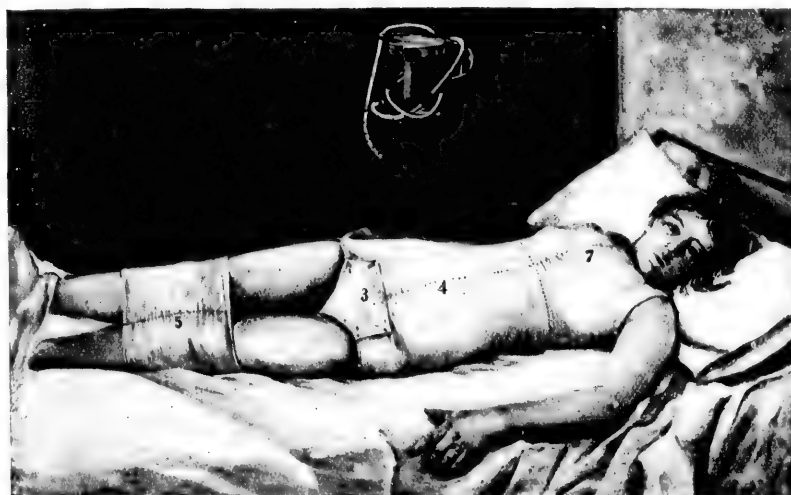


FIG. 422.—Garrigues's bandages, douche-can, and intra-uterine tube: 1, douche-can; 2, intra-uterine tube; 3, perineal pad; 4, belly-binder; 5, knee-binder; 6, suspenders preventing knee-binder from sliding down; 7, breast-binder (from a photograph).

for larger portions of membranes. If, however, the rope formed by the membranes breaks and the uterine end is within reach, the writer sometimes ties a silk thread to it, since the retained piece, as a rule, can easily be removed the following day by pulling on this ligature.

Intra-uterine injections are used if the fingers, the hands, or the instruments

have been introduced into the uterus. The fluid injected is a 1 per cent. emulsion of creolin at a temperature of from 110° to 115° F. The apparatus used for the injection consists of a douche-can (Fig. 422,¹), and a glass tube (Fig. 422,²), having a hole at the end and several on the sides near the end. Before introducing the tube into the uterus the vagina is irrigated. Great care should be taken in introducing the tube. The distance from the fundus uteri to the rima pudendi should be measured by holding the tube over the abdomen and noting how far the tube is to be inserted. The left index and middle fingers are introduced into the cervical canal and the tube is inserted between them. It should be ascertained if the tube goes in the direction of and reaches the fundus; this can be done by feeling the resistance offered by the latter, or frequently by feeling the end of the tube through the abdominal wall. If any difficulty is met with, the tube should be withdrawn a little and reintroduced in another direction. The douche-can should be held not higher than a foot above the uterus. At the end of the injection the fluid remaining in the uterus should be pressed out.

Dressing.—After the removal of the placenta the patient is again washed with bichlorid and the coagula removed from the pubic hairs, or, if the latter are long and matted together, they should be cut off. It is the routine practice in the Maternity Hospital to hold the uterus compressed for half an hour after delivery. At the end of this time an occlusion bandage (Fig. 422,³) is laid over the genitals and fastened to the binder (Fig. 422,⁴). This bandage consists of a piece of absorbent lint (12 by 8 inches, folded twice, so as to be 3 inches wide) reaching from the genito-femoral furrow on one side to that on the other side and covering the vulva and the anus. This pad is first wrung out of the creolin emulsion, and after being applied is covered with a piece of oiled muslin measuring an inch more than the pad in both directions. This oiled muslin is washed with creolin and is turned forward on the inner side of the thighs. Outside of the muslin is placed a somewhat larger pad of dry cotton batting, which is held in place by a piece of unbleached muslin half a yard square and folded like a cravat (5 inches wide), which in front closes a Λ -shaped opening left at the lower end of the binder, and which is fastened to the binder with four pins. Behind only two pins are needed. This dressing is changed every six hours and every time the patient urinates or has a movement from the bowels. On making the change a bed-pan is pushed in under the patient, and the outer surface of the genitals is irrigated with creolin. No vaginal injection is used. The genitals are not even touched.

Ergot.—Contraction and involution being great preventatives of puerperal infection, a drachm of fluid extract of ergot is given three times a day until an ounce has been used.

Perineorrhaphy.—All lacerations of the perineum are repaired immediately, the best material for suture being silkworm gut.

Catheterization.—When the patient is unable to urinate, the vestibule is washed with creolin emulsion and a well-disinfected catheter is introduced. The common flexible catheters, made of some woven fabric covered with varnish, are

strictly prohibited, as they cannot be kept clean. The best catheters are of metal or of glass, which can be boiled and be kept aseptic in a solution of carbolic acid (5 per cent.). If, exceptionally, a flexible catheter is needed, it should be of soft rubber, which is disinfected with the 5 per cent. solution of carbolic acid.

Syringes.—If injections are used, great care should be taken to disinfect the syringe nozzle by boiling and immersing it in a solution of corrosive sublimate. Nozzles employed in a serious case should preferably be destroyed, as glass nozzles only are used, and they are quite inexpensive.

Very much has been written during the last ten years respecting prevention of puerperal infection, and opinions concerning it differ greatly among leading obstetricians; for instance, regarding the use of ergot, which some extol and others look upon as a direct promoter of infection; vaginal injections, which in the eyes of some are superfluous or harmful; and vaginal examinations, which some fanatics would abolish altogether. But since none have had better results than the New York Maternity Hospital, with a total mortality of 4 in 1059 cases, and few as good, the writer does not recognize any reason for changing a treatment that has served so well for over ten years. The only change made by the writer is to substitute creolin (1 per cent.) for corrosive sublimate for vaginal and intra-uterine douches, on account of its greater safety,³⁹ and, so far as known, some of his colleagues yet use bichlorid (1 : 4000).

II. PREVENTION OF PUERPERAL INFECTION IN PRIVATE PRACTICE.—

The benefit of the antiseptic treatment in hospitals has been so enormous that all criticism has been silenced and every doubt has vanished. From one end of the civilized world to the other the treatment is essentially the same. But how different is it when we come to private practice! So recently as 1875 the International Congress of Physicians and Surgeons assembled at Brussels, Belgium, adopted resolutions to the effect that, on account of the great mortality in lying-in asylums, all such institutions should be abolished. Since that time the tide has turned. The hospital is now the safe place for a woman to be delivered in; it is in private dwellings that the danger lurks. The poorest, the dirtiest, and the most dissolute women are safely confined in a lying-in asylum; the richest, the youngest, the purest, and the loveliest sometimes succumb in giving birth to a child in their own homes. In the private obstetric practice of the writer there is neither death nor sickness referable to infection, while in consultation practice he frequently sees death follow childbirth or abortion. What is the cause of the difference? It is only that the writer uses strict antisepsis, and that many general practitioners do not. Some smile benignly at the mere thought of using such superfluous measures in private practice; others have a little mercuric chlorid or carbolic acid around the house, but use it without system or perseverance. Still, there is much greater danger of the patient being infected by the doctor or the nurse in private practice than in a well-appointed lying-in asylum. The young men composing the house-staff of a lying-in asylum are strictly forbidden to enter the wards

of a hospital; they have no private practice; they do not see an autopsy; and if, unfortunately, the asylum is a department of a general hospital, the clothes and the bodies of the nurses before going from one department to another are subjected to thorough disinfection under the supervision of their superiors. In private practice, on the contrary, the physician may have treated a case of diphtheria or of erysipelas a moment before being called to a confinement; and nearly all private nurses take promiscuously medical, surgical, and obstetrical cases, disinfecting themselves as best they know how or according as the combat between innate laziness and acquired conscientiousness prompts them.

As a matter of fact, the mortality in private practice is twice as large as that in hospital practice, or larger. *Out of every hundred, ninety-five, or even eighty-nine women delivered in New York or other large cities in private practice, one dies; that is, up to 1.12 per cent. against 0.6, 0.5, or even 0.4 per cent. in the best lying-in establishments.*

Country practitioners are still greater opponents of antiseptic midwifery than their professional brethren in the cities, the country practitioner relying on the purity of the atmosphere in which he works and on the robust constitutions of his patients. If, however, these conditions may help the women to get well, they cannot to any great extent prevent them from being taken ill. In many respects country practice exposes the patient even more to infection than does city life. In most places there is no drainage. Manure is spread over the fields or the garden close to the house in which live the farmer and his wife. The village butcher kills his cattle, lets the blood soak into the ground, and nails the skins to the barn-doors, whence their odor can be smelt far away. The country practitioner cannot go home and change clothes and bathe: he must make his round or he would never get through with his work; and thus it happens that the same hand that was thrust into a perineal abscess, that performed tracheotomy on a child suffering from diphtheria, or that dressed a patient attacked by bullous erysipelas, at the next house is brought up to the fundus of the uterus in order to take away an adherent placenta.

The same antiseptic precautions that have revolutionized lying-in asylums should be used as well in private practice, be it in the city or in the country. On October 27, 1892, the Obstetric Section of the New York Academy of Medicine unanimously passed the following resolution:

"Whereas, Experience both in this country and abroad shows that by strict antiseptic measures the total mortality in lying-in hospitals may be reduced to a few per thousand;

"Whereas, Deaths due to childbirth or to abortion are yet common in private practice;

"Resolved, That in the opinion of the Obstetric Section of the New York Academy of Medicine it is the duty of every physician practising midwifery to surround such cases in private practice with the same safeguards that are being used in hospitals."

In practice in well-to-do families we should choose a large, airy, sunny room, situated as far as possible from the water-closet. Should, however,

the lying-in room be close to the water-closet with a door leading directly from the one to the other, this door should be locked, and some of Platt's chlorid or other powerful disinfectant should be poured frequently into the basin.

Instead of lint, the writer uses for the pad in private practice absorbent cotton, and instead of oiled muslin he uses gutta-percha tissue. The pad is not changed in the middle of the night. The patient is directed to have two basins, two pitchers, and a fountain syringe, which articles are personally cleansed by the writer before bringing them into use.

In the dwellings of the poor the antiseptic precautions may be much simplified and yet be quite effective. The perineal pad may be made of common cotton batting, and the gutta-percha tissue may be dispensed with. A tin basin may be used instead of a bed-pan. The doctor can easily carry in his satchel some tablets of corrosive sublimate and a couple of ounces of creolin, and thus be prepared to disinfect himself and his patient at slight expense to himself and none to his patient. Intra-uterine douches can be made with a soft-metal catheter costing fifty cents, or with a *new* flexible catheter costing twenty cents. The uterine sound used as a stylet greatly facilitates the introduction of a flexible catheter.

No one can foresee—the average general practitioner least of all—what complications may arise during labor. Where an easy delivery has been promised the healthy primipara, it may become necessary to perform version, symphysiotomy, or craniotomy, the result of either of which operations depends almost entirely on the aseptic or septic condition of the patient at the time of its performance, taking for granted that the operator uses all antiseptic precautions. *The doctor and the nurse should know that they jeopardize their patient's life by introducing into her vagina a finger that is not disinfected.* During labor dangerous microbes will not be destroyed by phagocytes or by the chemical composition of the secretions, as we are told they are under other circumstances. Upon the whole, labor in private practice should be conducted essentially in the same way as that described for lying-in hospitals.

III. CURATIVE TREATMENT OF PUERPERAL INFECTION.—The curative is much less effective than the preventive treatment. Since infection, in the vast majority of cases, takes place in the genital canal, the first indicated procedure is the removal of the microbes that have not yet entered the tissues, which removal is effected by ablution and injection with antiseptic fluids. The second procedure is to seal the entrances, which is done by means of cauterization. A third procedure is to clean the intestinal canal by an aperient or by enemas. A fourth procedure is to sustain the strength of the patient in order to give her a chance to throw off the poison that already has entered her tissues or that circulates in her blood. Stimulants are therefore used freely; as much food is given as it is possible for the patient to digest; and tonic drugs are administered. A fifth procedure is to combat pain, which indication is met by narcotics and ice. The sixth and final procedure is to reduce the patient's temperature if it becomes dangerously high, which is done by ice-bags, by an ice-water coil, by refreshing ablutions, or by cooling baths.

In describing the details of the treatment followed in combating puerperal infection the same anatomical categories will be used as in the preceding pages, but the reader must bear in mind that what is described under different headings is really one and the same disease, modified only by the intensity of the affection or by the nature of the tissue affected. To avoid endless repetitions, a mode of treatment will, as a rule, only be mentioned under that organ in the affections of which it is chiefly employed, but with the understanding that a similar condition in another organ calls for similar measures. Thus the means of reducing the temperature are discussed under *Peritonitis*, but what is said there applies as well to cases in which there is a high temperature without peritonitis.

Sometimes the lochial discharge becomes fetid, there is a moderate rise in the temperature not exceeding 102° , some acceleration of the pulse, but no tenderness, no swelling, and no ulceration. This condition is probably due to a *very mild degree of infection with saprophytes*. Often a blood-clot hidden in the deep pouch at the posterior fornix or in the interior of the uterus is the cause of such a condition. Health is, as a rule, soon restored by using disinfectant vaginal injections of creolin or of carbolic acid every three hours, by moving the bowels, and by administering 5 grains of quinin three or four times a day.

Vulvitis and Vaginitis.—The catarrhal inflammation of the external genitals calls only for the above-mentioned vaginal douches three times a day. Simple ulcers may besides advantageously be dusted with iodoform, with dermatol, or with stearate of zinc, or be covered with iodoform ointment:

R. Iodoformi,	3j ;
Balsami peruviani,	3ij ;
Vaselini,	3ij.—M.

If the sores become diphtheritic, it is the practice of the writer to touch them with a solution of chlorid of zinc:

R. Zinci chloridi,	
Aquæ destillatæ,	āā 3j,

which is applied by means of a stick wound with absorbent cotton. The caustic should be applied very thoroughly, and be held in contact for a minute. The vagina is then syringed with creolin or with carbolic acid.

If the perineum has been stitched, the sutures should be removed, as the torn surface is already or will be infected, and it must be treated in the above-mentioned way. Tears in the deeper part of the vagina are exposed by means of a speculum. The application of zinc being very painful, the parts should be made insensible with a 10 per cent. solution of cocain, or general anesthesia must be produced. The vaginal injections are repeated every three hours. Once in twenty-four hours the parts are inspected, and if new patches have formed the same procedure is repeated.

The application of chlorid of zinc brings out the diphtheritic infiltration much more distinctly, the affected part becoming milk-white. Later, there is formed a grayish slough which is very much like a diphtheritic patch. To distinguish old sloughs from new patches the physician must remember where he has cauterized the preceding day, and pay attention to the contour of the affected place. A slough produced by cauterization has a plain curved outline, while that of a new diphtheritic patch has a scalloped outline, the infiltration spreading more rapidly at one point than at another.

The object to be attained by cauterization is both to kill the microbes found in and near the wound, and to seal lymphatics and veins leading from the ulcer to the deeper parts. The writer has found chlorid of zinc much more effective for this purpose than tincture of iodine, iodoform, liquor ferri sulphatis, or liquor ferri chloridi.

The general treatment consists in giving an aperient if the bowels have not moved freely, 5 grains of quinin every four hours, half an ounce of brandy or of whiskey with equal parts of milk or water every two hours. For a change egg-nog may be substituted two or three times a day. If strong liquor is not well borne, it may be replaced by a corresponding amount of port, sherry, tokay, or angelica wine, but, as a rule, alcohol can be taken in large amounts without producing intoxication.

If there is *gangrene* of the vulva or of the vagina, the stimulant treatment should be pushed still more, the dead tissue should be removed with knife and scissors as soon as feasible after the formation of a line of demarcation, and healing be promoted with iodoform or with camphor emulsion (see under *Bed-sores*).

Endometritis and Metritis.—If the large size of the uterus, its tenderness, and the discharge of a dirty and offensive fluid show that the uterus itself is the seat of inflammation, the question to be decided is whether it is empty or whether it contains parts of the secundines. If there is the slightest doubt in this respect, the first thing to be done is to anesthetize the patient, place her on a table, in the dorsal posture with elevated bent knees. The physician then lubricates his hand and introduces it into the vagina, thrusting one or two fingers into the interior of the womb. If necessary, the whole hand may be introduced. In either case the operator should examine systematically the whole endometrium, and especially be sure to reach both ostia uterina of the Fallopian tubes, where often a piece of placenta is retained. The finger-nails are used as scrapers. The other hand of the physician is laid flat on the fundus, steadies the uterus, and brings the fundus within easier reach. If possible, it is of great advantage to enter the finger at one edge of the part to be removed and to take away the part in one piece. Often, however, we must remove the part piecemeal. It is not necessary to withdraw the hand. By pressing the loosened part between the fingers and the palm of the hand the tissue to be removed is made to follow the inner surface of the arm down to the os.

If the uterus has contracted too much to allow the hand to be introduced,



and the obstetrician cannot reach the fundus with the fingers, even by pressing well on it from the outside, he may employ instead a large dull wire curette. This instrument is 14 inches long, has a shank a quarter of an inch thick, and an eye large enough to admit the tip of the thumb. In using the curette the writer as a rule prefers to place the patient in the Sims position. He has used the wire curette as early as the end of the second month of pregnancy in abortion cases, after having dilated the cervix with Hanks's and his own dilators. At a still earlier period the writer uses the Simon sharp spoon. Whenever it is possible the left forefinger should be introduced beside the large curette, so as to be able to feel the part to be removed and to seize it between the finger-tip and the eye of the curette, which is safer than any kind of placental forceps. The curette is not only used to remove secundines, but may also be used to scrape away spongy tissue belonging to the uterus itself.

Many obstetricians are opposed to the use of the curette in obstetric cases, maintaining as an argument that new wounds are produced by it, and that blood accumulates and forms a fertile soil for bacteria.⁴⁰ In the writer's experience the curette is of great value—nay, indispensable—in abortion cases, but after confinement he always uses the hand if possible. If the instrument is first used after the poison is no longer localized and the patient is profoundly septic, the curette can accomplish very little.

When the internal surface is smooth the uterus is washed out with two or three pints of creolin (1 per cent.) or of carbolic acid (2 per cent.), the patient being in the dorsal decubitus. If there is much bleeding, this intra-uterine douche should be given quite hot (115° F.). If an anesthetic is not administered, hot water is very painful, and lukewarm water is preferred, except to check hemorrhage.

Some obstetricians pack the uterine cavity with iodoform gauze. In obstetric cases, which alone concern us here, the writer prefers the introduction of an iodoform suppository:

R Iodoformi,	3v ;
Amyli,	3ss ;
Glycerini,	f5ss ;
Acacie,	— M

Ft. suppositoria No. iij, of the size and shape of the little finger.

The use of such a suppository renders frequent repetition of the intra-uterine douches superfluous. As a rule, the suppositories are used only once in twenty-four hours.

The suppository is introduced through a bivalve speculum by means of a forceps having a curvature like that of the uterine sound. A common dressing forceps is unsuitable for this purpose, as it does not penetrate far enough and it is apt to wound the uterus. Sometimes it is unnecessary to repeat the intra-uterine treatment, the condition of the patient being satisfactory. Vaginal douches are used instead, and they are also employed as

a supplement to the intra-uterine injections. They are given every three hours.

Before emptying the uterus it is a good plan first to wash it out with several liters of boiled water, which washing removes a great many microbes that otherwise might be carried into the tissues with the nails or the curette, causing a chill followed by fever. The effect is merely mechanical, and the result in preventing chills and fever is just as good with plain sterilized water as with solutions of bichlorid of mercury, carbolic acid, or lysol.⁴¹

If several days have elapsed since the infection took place, Bumm recommends the use of the curette. Under such circumstances he states that packing with iodoform gauze is much to be preferred to injections. The gauze keeps the uterus dry and prevents the propagation of putrefaction. In septic infection—that is, when the microbes at work are of the pathogenic kind—these measures become much more unreliable.

The intra-uterine injections reached their acme when *permanent irrigation* was recommended. The uterus was first washed out with a 5 per cent. solution of carbolic acid, after which washing a continuous stream of Minnich's solution—that is, water containing 10 per cent. of sulphite of sodium and 5 per cent. of glycerin—was kept circulating through the uterus by means of two rubber tubes introduced up to the fundus. This treatment has, however, been abandoned, even in Germany, where it originated, as it does no good, but, on the contrary, does a great deal of harm.⁴²

Even in regard to common intra-uterine injections opinions vary very much among leading obstetricians, and upon the whole the tendency is rather to restrict their use considerably. Pippingsköld of Helsingfors, Finland—who has, or at least during four years from 1884 to 1887 had, the smallest mortality the writer ever saw mentioned, namely, 0.29 per cent.—uses them only once or twice a year in a service varying from five hundred to eight hundred patients per annum.⁴³ Schrader condemns them altogether, because they provoke uterine contractions, and thereby a rapid circulation of lymph, which promotes general infection.⁴⁴ According to Bumm, the intra-uterine injections are good in putrid endometritis, and even in the septic form if the microbes have a low degree of virulence, in which case the process remains local; but in other cases they do more harm than good.

The virulent microbes rapidly invade the tissues. In cases of infection from another puerpera or from a patient affected with erysipelas, diphtheria, phlegmon, etc., the local treatment comes too late. When there are clinical signs of absorption—pelvic peritonitis or metastases—local treatment is useless, and it may do harm by inflicting new wounds, by tearing open agglutinated ones, by disturbing beginning encapsulation of septic foci, by causing the displacement of infected thrombi, etc.⁴⁵ Frank uses 6 to 8 liters to wash out a uterus.⁴⁶ Kroenig found that in septic infection there were as many streptococci a few hours after intra-uterine antiseptic injections as before, and that their virulence, tested on rabbits, was undiminished.⁴⁷

Tamponage with iodoform gauze may occasionally be valuable. Thus a

case is reported in which the placenta had been retained for eight days. When the doctor found he could not remove it he tamponed the uterus. The following day he removed a part of the placenta with the curette, tamponed again, and the next day removed the remainder of the placenta with the curette.⁴⁸ The gauze ought to be removed soon, but not all at once, since the uterus cannot contract in proportion.⁴⁹

Involution is promoted by the administration of ergot and the application of the faradic current, both poles being applied externally, one at the fundus, the other alternately at both sides just above the pelvic brim.

Inflammation, and especially pain, are combated by means of an ice-bag placed on the abdomen just above the symphysis. To avoid local freezing four layers of muslin should be laid between the bag and the skin. Instead of the ice-bag there may be used a rubber coil through which ice-water is made to circulate. The ice-bag or the coil is to be kept on continually day and night.

Cold is preferable to heat, as it is more soothing, abridges the course of the disease, and perhaps even has some direct antiseptic value, certain microbes being restrained from developing,⁵⁰ while a moist warm application offers the very best chances for the development of all lower life. If, however, cold is contra-indicated, as in diarrhea, low vitality, puerperal diphtheria, etc., warm flaxseed-meal poultices should be placed on the abdomen.

When the disease enters on a more subacute stage, the writer uses a Priessnitz compress; that is, a towel wrung out of cold water, placed on the abdomen, and covered with some waterproof material. The pad becomes warm in a quarter of an hour, and is renewed four times a day. This transition from cold to heat is a very powerful absorbent, and it is well liked by patients. Internally there are given 5 grains of quinin four or six times a day, small doses of an opiate *pro re nata*, and a moderate amount of stimulants.

If inspection of the cervix shows diphtheritic patches, the treatment is much more energetic; then the whole cervix up to the os internum is cauterized with the above-mentioned solution of chlorid of zinc, the uterus is washed out with antiseptic fluid, and there is left in it an iodoform suppository. These injections are repeated once in twenty-four hours, and a new suppository is introduced. This treatment is continued until all sloughs are thrown off and fever has ceased. A warm poultice is applied over the abdomen. Large and frequent doses of strong stimulants should be given—at least half an ounce of whiskey or of brandy every two hours.

Digitalis may be needed as a heart tonic, preferably in the form of the official infusion (℥ss, four times a day); but if the patient cannot swallow or vomits the medicine, the tincture may be injected hypodermatically in doses of from 5 to 10 minims, repeated according to circumstances. Tincture of strophanthus in doses of 5 or 6 minims is also an excellent heart tonic. Quinin is given in moderate doses, not with a view of reducing the temperature, but as a tonic and antiphlogistic, one of the properties of this drug being to prevent the migration of the leucocytes from the blood-vessels.⁵¹

In *dissecting metritis* the process of elimination is often so protracted that the use of poisonous antiseptics, such as corrosive sublimate and carbolic acid, becomes dangerous. Under such circumstances the writer has found a saturated solution of boric acid suitable. All intra-uterine injections should be warm, as a cold fluid sometimes causes collapse.

Putrescence of the uterus is a condition that has disappeared from all well-ordered lying-in institutions since strict aseptic or antiseptic treatment has been introduced. If a case should come under the observation of the writer, he would treat it with creolin injections, iodoform suppositories, alcohol, quinin, and albuminoid food. If possible, dead tissue should be removed with the large dull-wire curette, but the operation is dangerous, and it should be performed with the utmost care, as there is considerable danger of perforating the soft uterine wall, and infection of the new wounds might aggravate the patient's condition.

Cellulitis and Adenitis are treated with the ice-bag, and later with the Priessnitz compress. If the resolution is unduly slow, the abdominal wall over the swelling should be painted once a day with tincture of iodine. After this application has been repeated for a few days, and the epidermis has become hard, the writer covers the abdominal wall with a piece of lint soaked in the following wash:

R. Acidi carbolici,	3j;
Glycerini,	
Aquæ,	āā. ʒiij.

This preparation softens the epidermis, prevents cracking, and promotes absorption of the iodine.

When the tenderness has been so much reduced that a speculum may be used, it is well to combine the external painting with that of the vaginal vault, and thus bring the iodine more in direct contact with the affected part. This application is repeated every three days. Care should be observed to take so little of the tincture on the brush or applicator that it does not trickle down to the vulva, where it burns, while it is not felt at all on the fornix. In ambulant patients it is well to wipe off the redundant tincture with absorbent cotton before they rise from the table.

If suppuration sets in, it should be hastened by means of warm flaxseed-meal poultices; when the abscess is formed it should be opened with the knife through the skin or the vagina, or both. If there is any doubt as to the presence of pus, it may be settled by using a hypodermic syringe or an aspirating needle. The common hypodermic syringe is too short, but one may be made having an attachment to the case and the piston.* If there is pus, the needle may be used as a guide for the knife. Some surgeons use a trocar. Dr. Bache Emmet constructed a trocar that at the same time carries a drainage-tube.⁵² Some canulas have holes through which they may be fastened to the

* A very satisfactory instrument of this kind has been made for the writer.

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vagina with silver wire. Both in puncturing and in cutting, the wound must be made behind a line drawn transversely through the cervical canal, in order to keep clear of the ureter and of the uterine artery. The surgeon should likewise feel for and avoid vaginal arteries. Often one or more drainage-tubes are inserted.

These operations should be performed with full antiseptic precautions. The best way of disinfecting the vagina is to rub it with tinctura saponis viridis carried on absorbent cotton or on gauze held in a long forceps, and to irrigate with corrosive-sublimate solution (1 : 2000).

If an abscess communicates with the intestine and does not close, a counter-opening should be made in the abdominal wall or in the vagina, and thorough drainage be established. If a fistulous tract remains leading from the pelvis to the vagina or the skin, and the patient's life is in danger from exhaustion, a cure may yet be accomplished by vaginal hysterectomy, with or without salpingo-oöphorectomy, but the operation may be a very difficult undertaking. The internal treatment is the same as stated before.

Lymphangitis.—Lymphangitis of the vulva and the groin is treated with compresses soaked in a lead-and-opium wash :

R_x. Tincturæ opii, ℥ss ;
 Liquoris plumbi subacetatis diluti, q. s. ad ℥viij.—M.
 Sig. For external use.

If the inflammation runs into suppuration, the treatment is the same as that above described for suppurative cellulitis. Lymphangitis of the uterus is treated with ice-bags, opiates, saline aperients, quinin, and alcohol.

Peritonitis.—Opinions are much divided as to the advisability of using antiseptic intra-uterine injections in peritonitis. Personally, the writer gives one injection, on the assumption that besides the microbes which already have found their way from the uterus to the peritoneal cavity, and which are beyond reach, there may be others in the uterine cavity that it may be advantageous to remove. The writer has never seen any bad effect from this practice, while sometimes it seemed to do good.

The abdomen is covered with two large ice-bags, whose weight is diminished by suspending them from a cradle. Instead of the ice-bags, a rubber coil with circulating ice-water may be employed. It is only when the above-named counter-indications against ice are present that a warm flaxseed-meal poultice should be substituted.

A remedy of the greatest value in puerperal peritonitis is opium, given in as large doses as the patients can stand—and they can stand enormous doses—the only indication to stop being the condition of the respiration. It is perfectly safe to give the drug in doses repeated at short intervals until the respiratory movement sinks to 14, or even to 12, per minute. The best opiate for this purpose is morphin. To relieve pain as promptly as possible it is well to begin with a hypodermatic injection of a quarter of a grain of the drug. Afterward

it is better to give the medicine by the mouth, because too many injections would be needed; because they ought only to be given by the doctor; because the medicine is brought directly to the affected part; and because hypodermatic injections, if not given with the greatest care, disinfecting both the instrument and the skin, are apt to cause abscesses which may prove a serious, even fatal, complication. In this way $\frac{1}{8}$ to $\frac{1}{4}$ grain is given every half hour until the patient is fully under the influence of the drug—that is to say, is free from pain, and yet not in a deeper narcosis than that from which she can easily be aroused.

Lawson Tait pointed out the danger of using opiates after laparotomies, and the advantages of moving the bowels. This treatment, which undoubtedly is a great advance in gynecology, should, in the writer's opinion, not be applied to puerperal peritonitis. In the writer's younger years the treatment with aperients was in vogue, and he is still harassed by the memory of the poor tortured women who were plied with senna and were given insignificant doses of opium; with that plan the mortality was much greater. With the "opium plan" he has saved one-half of the cases affected with general peritonitis.⁵³ Others have, however, diametrically opposite views on this subject. Gottschalk, for instance, keeps the bowels open and rarely uses opiates.⁵⁴

If morphin has too depressing an effect, especially if the heart is weak, atropin may be added to the morphin. By adding 1 part of atropin to 1000 of Magendie's solution the latter may be given according to the above rule:

R_y. Atropinæ sulphatis, gr $\frac{1}{8}$;
Solutionis morphinæ (Magendie), ʒij.—M.

Sig. Four to eight minims as prescribed.

Alcohol should likewise be given in very large doses, from half an ounce to one ounce every two hours or oftener. The writer gives quinin in the moderate dose of 5 grains every four hours, which periods of administration keep up the influence of the drug continually.

No aperient medicine is given. An evacuation takes place from time to time spontaneously, and if it does not an enema is given. Pure glycerin (ʒij-ʒj) may be used. The hygroscopic property of the glycerin attracts much fluid, softens scybala, and lubricates the passage. Another good rectal injection is composed of a quart of flaxseed-meal tea with a tablespoonful of castor oil and a teaspoonful of oil of turpentine. A still more powerful enema is made of inspissated ox-gall (a teaspoonful) or fresh gall (a tablespoonful), glycerin and castor oil (a tablespoonful of each), table salt (a heaping teaspoonful), and flaxseed-meal infusion (a tablespoonful to a quart of water).

Frank has seen excellent results from the subcutaneous injection of pure creasote 3 grams (45 minims) *pro die*, or from an emulsion of creasote and oleum camphoratum, *ad*. half a gram (8 minims), beginning with 0.5 gram morning and evening, and increasing the dose gradually. The injection is made deeply into the gluteal region or into the muscles of the spine.⁵⁵

Occasionally digitalis or strophanthus may be used as a heart tonic, and strychnin is employed as a general tonic, especially as a tonic for the respiratory organs. When used as a respiratory stimulant the hypodermatic method is preferable.

For vomiting cocain and hydrocyanic acid are the best remedies. The hydrochlorate of cocain may be given by the mouth or hypodermatically (gr. $\frac{1}{2}$, repeated every two hours). The hydrocyanic acid the writer gives by the mouth in the following mixture:

R. Acidi hydrocyanici diluti,	℥ss ;
Acidi citrici,	
Sodii bicarbonatis,	āā. ʒij ;
Syrupi rubi Idæi,	℥ss ;
Aquæ destillatæ,	ad ʒvj.—M.

Sig. A tablespoonful every one, two, or three hours.

An ice-bag placed over the pit of the stomach is also useful in restraining vomiting.

The diet consists of milk, beef-tea, and oatmeal gruel. The beef-tea may be made of fresh minced meat, which is put into a bottle with just water enough to touch all the meat, the water being acidulated by adding a little dilute hydrochloric acid. The bottle is corked and boiled for an hour in a pot of water. This beef-tea makes a very strong, nourishing, and stimulating food, which is taken with a teaspoon. If more bulk is desired, the beef-tea is prepared by taking a pound of minced beef, a teaspoonful of dilute hydrochloric acid, and a pint of cold water. This mixture is left for an hour or more, and is stirred every quarter of an hour ; it is then placed over the fire, and is taken off as soon as it reaches the boiling-point. It is strained through a cloth, and salt is added to taste. The beef-tea may also be made with the different prepared extracts, such as those of Valentine, Armour, or Mousquera. Liebig's meat extract is less suited for this purpose. Max Runge and his followers give even solid food—eggs, veal cutlet, and ham.⁵⁶

To give an idea of the amount of morphin, alcohol, and food that may be administered, the writer may mention that one of his patients who recovered took in twenty-three days 216 grains of morphin, 228 ounces of whiskey, 1078 ounces of milk, and 418 ounces of beef-tea, making an average of 9 grains of morphin, $9\frac{1}{2}$ ounces of whiskey, 45 ounces of milk, and $7\frac{1}{2}$ ounces of beef-tea in twenty-four hours. The greatest amount of morphin given in one day was $13\frac{3}{4}$ grains.

Many obstetricians make extensive use of antipyretic remedies—large doses of quinin, salicylate of sodium, antipyrin, antifebrin, phenacetin ; others are strenuously opposed to their use, and the writer belongs to the latter category. These drugs rather mask than cure the disease. Some of them—salicylate of sodium and antipyrin—are particularly objectionable, because they weaken the patient. The best is phenacetin (gr. v every four hours), since it lowers

the temperature, combats pain, and does not to the same degree weaken the heart. In this class may be reckoned carbolic acid, which the writer has given with good effect in cases of offensive diarrhea:

R. Acidi carbolici purissimi,	
Liquoris iodi compositi,	āā. ℥xvj;
Mucilaginis acaciæ,	fl.℥ij;
Syrupi aurantii,	℥ss;
Aquæ destillatæ,	q. s. ad ℥viij.—M.

Sig. A tablespoonful every hour.

The best way of reducing the high temperature is the external application of cold. In addition to the ice-bags on the abdomen an ice-cap may be placed on the head, for which purpose some are made in the shape of a helmet. It is grateful to the patient to be washed over the whole body with equal parts of alcohol and cold water, but this has a more refreshing than a really antipyretic effect. The latter is obtained by a Kibbee fever-cot, the cold pack, or the cold bath. The fever-cot consists of a wooden frame having a network of cord, under which is a rubber sheet forming an inclined plane toward one end of the cot, where a water-pail is placed. A folded blanket is laid over the netting to protect the patient against being cut by the cords, and a rubber-covered pillow is laid at the head of the cot. A folded sheet is laid across the middle two-thirds of the cot, the patient being so placed that this sheet reaches from her armpits to the trochanters. Her clothes are drawn up, and her legs are covered with woollen stockings and a blanket. Bottles containing hot water may be placed against the soles of her feet. The sheet is folded over the patient's chest and abdomen, and water is poured gently from a pitcher over the sheet, beginning with water at a temperature of from 85° to 90° F., and gradually diminishing it to from 75° to 80° F. This application is continued for a quarter of an hour, when the patient is covered up. At the end of each hour the procedure is repeated if the temperature again rises.

Where the fever-cot is not obtainable the cold pack may be substituted in the following way: Two beds are each covered with a rubber or an oil-cloth sheet, over which is placed a blanket, and over the blanket is laid a muslin sheet wrung out of cold water. The patient is placed on the wet sheet, which is wrapped around her except at the feet. If the circulation is bad, hot-water bottles or hot-water bags may be placed against the soles, one or two blankets being laid over the patient. At the end of ten minutes she is removed to the second bed, where the same procedure is repeated. Four or six such packs may be needed to reduce the temperature as much as is wanted, and the handling of the patient may cause her pain and necessitates the help of three nurses.

The patient is less disturbed by the cold bath, which is a powerful refrigerant, and which should be given in the following manner: A bath-tub is

filled with water slightly below blood-temperature, into which bath the patient is gently let down, carrying her on the sheet of the bed upon which she has been lying. The water is then gradually cooled by withdrawing warm and substituting cold water, until it reaches 80° F. It is well to give the patient a tablespoonful of brandy before the bath, and she must be watched carefully by the physician while she is in the bath; at any sign of collapse she should be removed from the bath; otherwise she may remain in it for fifteen or twenty minutes.

In local peritonitis laparotomy is indicated if milder remedies have not the desired effect; and since it is often difficult to decide whether the peritonitis is general or is localized, it is better to give the patient the benefit of the doubt. Several cures under such circumstances have been reported.⁵⁷

By turning out the large curdled masses and the sero-fibrinous or the purulent fluid, washing out the peritoneal cavity with peroxid of hydrogen, and leaving a glass drainage-tube for further escape of the fluid or gas, it would seem that we increase the chances of the patient; but if we want to operate at all, we should not wait until her whole system is poisoned and death is imminent. The condition is not totally different from cases of rupture or of gunshot wounds of the intestine or of the bladder, in which early operation yields very fair results, and certainly much better than the expectant method.*

Still, as some patients recover by medical treatment, and since in fatal cases the operation may seem to have caused the death of the patient, recourse to laparotomy has so far been rather limited during the acute stage of the disease. If the patient gets over this stage and there are left encysted peritonic exudations, the operation ought to be performed.

Pleurisy.—If the infection locates in the pleura, producing pleuritis, there should be applied to the chest an ice-bag, which is not only very effective in soothing the pleuritic pain, but also abbreviates the course of the disease. If, however, the affected part cannot be reached, warm applications should be preferred, either flaxseed-meal poultices or spongiopiline—that is, a piece of gutta-percha-covered felt which only needs dipping into hot water.

In the exudative form of pleurisy tincture of iodine may be painted on the skin. Internally, the iodid of potassium and diuretics are given, for example:

R. Tritici repentis radicis decoctionis, ʒss-ʒviij;
Potassii acetatis,
Potassii bitartratis,
Potassii citratis, āā. ʒj.—M.

Sig. A tablespoonful from four to six times a day.

The amount of fluid in the pleural cavity is rarely large enough to call for thoracentesis by aspiration. If the fluid becomes purulent, the empyema should be operated on by resection of a piece of a rib.

Pneumonia.—When the lungs become inflamed, the chest should be cov-

* T. H. Burchard collected 39 cases with 23 recoveries; that is, 60 per cent.⁵⁸

ered with large warm flaxseed-meal poultices well protected with oiled muslin, and a flannel binder with shoulder-straps of flannel. These poultices need not be changed more than four or six times in twenty-four hours. Stimulants and tonics are highly indicated. A favorite prescription of the writer is citrate of ammonia, obtained by mixing the carbonate with citric acid :

R_x. Ammonii carbonatis, ʒij.

Div. in chart. No. xij.

Sig. No. 1, one powder four times a day.

R_x. Acidi citrici,
Sacchari, āā. ʒij.—M.

Div. in chart. No. xij.

Sig. No. 2, one powder four times a day, mixed with No. 1.

Perhaps this preparation serves to dissolve the fibrinous exudation, or perhaps it only acts as a stimulant. Care should be taken to change the position of the patient to prevent stagnation of blood by gravitation. If edema supervenes, dry cupping is valuable.

Endocarditis and Pericarditis.—If the pericardium is inflamed, the treatment consists in the same external applications and diuretics as those recommended for pleuritis. The inflammation of the endocardium is hardly within reach of therapeutic measures. Ice-bags, digitalis, and strophanthus may, however, be tried.

Enteritis.—Offensive diarrhea is best combated with internal antiseptics—a minim of carbolic acid in a mucilaginous menstruum, repeated every hour, combined or not with the same amount of liquor iodi composita; naphthalin (gr. ij–vij every two hours); or salol (gr. v every two hours). Enemas with a teaspoonful of starch and 25 drops of laudanum give great relief when the patient suffers from tenesmus. A heaping teaspoonful of subnitrate of bismuth may be added to advantage.

Hepatitis.—Pain in the right hypochondrium may be relieved with an ice-bag or with a flaxseed-meal poultice. If the bowels are constipated, calomel (gr. v–x) is preferred as an aperient on account of its cholagogue properties.

Nephritis.—A warm flaxseed-meal poultice, or a bag with digitalis leaves dipped in hot water, is placed under the loins. Diuretics are given (see *Pleurisy*). Small doses of chloral hydrate (gr. xv–xx one to three times a day) diminish the albumin in the urine. Chlorid of iron may be given in the following form:

R_x. Tincturæ ferri chloridi, ʒss;
Syrupi simplicis, ʒj;
Aquæ, q. s. ad ʒviiij.

Sig. One tablespoonful four times a day.

To protect the patient's teeth she should be directed to gargle with a solution

of sodium bicarbonate (3ij-3viiij) after taking the medicine. Warm baths are useful.

If uremic symptoms appear, elimination through the skin and the intestine must be attempted. To accomplish elimination through the skin the most powerful means is a hot-air bath, which may be obtained by placing an alcohol lamp under a chair beside the bed, an open umbrella over the abdomen of the patient, and then covering both with a waterproof. Perspiration, however, is weakening, and it ought not to be prolonged over two hours.

Free evacuation of the bowels should be obtained by the most powerful drastic purgatives, such as croton oil ($\frac{1}{2}$ drop every half hour) administered in pill form or in castor oil or in almond oil, or, if the patient cannot swallow, mixed with butter and rubbed on the tongue; common elaterium (gr. $\frac{1}{4}$ - $\frac{1}{2}$ every hour); Clutterbuck's elaterium (gr. $\frac{1}{8}$), elaterin (gr. $\frac{1}{16}$ - $\frac{1}{12}$), or gamboge (gr. 1 every half hour).

The diet should consist exclusively of milk, either in its natural state, or peptonized, or as koumiss, or as matzoon. These preparations of milk should be given only in small quantities (tablespoonful or even teaspoonful doses), and if even they cannot be retained recourse should be had to rectal alimentation with Leube-Rosenthal's solution, Rudisch's beef-peptonoids, or an egg with half an ounce of brandy and $3\frac{1}{2}$ ounces of milk.

Vomiting is combated by hydrocyanic acid, cocain (see *Peritonitis*), bismuth, strychnin, tincture of iodine, carbolic acid, creasote, or lumps of ice, and an ice-bag or a turpentine stupe applied to the pit of the stomach.

Encephalitis and Meningitis.—If localization takes place in the brain or its envelopes, little is to be expected of therapeutical measures. The head should be covered with the above-mentioned ice-cap or an ice-water coil. The bowels should be kept loose. Ergot and liquor barrii chloridi (℥v q. 4 h.) may be given, besides quinin, with a hope of causing contraction of the cerebral blood-vessels and checking the migration of white blood-corpuscles.

Delirium, restlessness, and insomnia are quieted by bromids, chloral, cannabis indica, opiates, sulphonal, or trional. *Abscesses* in the subcutaneous or subfascial connective tissue are opened and treated according to the rules of antiseptic surgery.

Arthritis.—If localization takes place in a joint, it should first of all be immobilized by proper splints and bandages, but in such a way as not to interfere with other treatment. In the beginning an ice-bag applied around the inflamed joint has often an excellent effect. Later, tincture of iodine or fly-blisters may serve as counter-irritants. If the effusion becomes purulent, the joint should be emptied with the aspirator-needle and be injected with a solution of carbolic acid (3 to 5 per cent.), creolin (2 per cent.), or peroxid of hydrogen. If this treatment does not suffice, the joint should be laid open by a free incision.

Skin.—Puerperal cutaneous eruptions hardly call for special treatment. If they itch, considerable relief may be obtained from bathing the skin with the following solution of carbolic acid:

R. Acidi carbolici,	3ss ;
Alcoholis,	
Glycerini,	āā. 3ss ;
Aquæ,	q. s. ad 3vj.

Bed-sores should be treated very carefully. As soon as the skin becomes red over the sacrum, the trochanters, the heels, or other places exposed to pressure, the patient should be placed on suitable rubber air-cushions, and so far as possible be shifted so as not to press on the affected spot. Under the heels are placed rubber rings filled with air, or a similar contrivance is improvised by winding a strip of muslin in a spiral line along a wad of oakum, thus forming an elastic ring into the opening of which the heel fits. The red spot is bathed frequently with lead-water.

If there is an excoriation, it should be dressed with glycerite of tannin (5j to 5j) or with the following ointment :

R. Iodoformi,	5j ;
Balsami peruviani,	5ij ;
Vaselini,	5j.

If gangrene has developed, the dead tissue should be removed with knife or with scissors as soon as a line of demarcation has formed, and the sore should be dressed with lint or cotton dipped in a 10 per cent. camphor emulsion or a 2 per cent. creolin emulsion :

R. Camphoræ,	3ss ;
Mucilaginis acaciæ,	5j ;
Aquæ,	q. s. ad 3v.—M.

Sig. Shake well. For external use.

When once the hole is filled by granulation the above-mentioned milder remedies may be substituted.

In severe cases much benefit is derived from placing the patient on a water-mattress, which adapts itself very evenly to the whole lower surface, and facilitates changes in position by the ease with which the water flows from one part of the mattress to another.

Phlebitis.—1. *Phlegmasia Alba Dolens.*—The affected limb should be painted once a day with tincture of iodine along the swollen veins, and be surrounded by cotton batting, slightly compressed with roller bandages, and elevated on cushions, so as to favor reflux of venous blood and lymph and to prevent stagnation and congestion. In protracted cases blue ointment may be substituted for the tincture of iodine, but to prevent tearing off a piece of a thrombus, which would form an embolus, the ointment should be smeared carefully on the skin, avoiding deep pressure. As there is great tendency to relapse, the patient should be kept quietly on a lounge or in an easy-chair with raised extremity for a fortnight after the swelling has subsided. Circumscribed

abscesses must be opened and be dressed antiseptically, and in cases of diffuse subfascial phlegmon several long incisions should be made at an early date to limit the destruction in the deeper parts.

2. *Inflammation of Varicose Veins.*—If varicose veins become inflamed, the limb is immobilized, and covered with cloths dipped in a lead-and-opium wash. The cloths are kept cool by evaporation and addition of new fluid or by changing them. If the cool application meets with objection, flaxseed-meal poultices may be substituted. After the acute stage has passed the limb is slightly compressed with a roller bandage, and when the patient begins to walk about the bandage is replaced by an elastic stocking.

3. *Uterine Phlebitis* calls for all the general and local treatment described in the preceding pages, especially quinin, alcohol, ice-bags or warm poultices, and hot vaginal douches.

Acutest Septicemia.—In those cases in which the infection takes such a rapid course that no local inflammations find time to develop there is scant hope of saving the patient's life. We should, however, try to better her chances by following the principles laid down above. High temperature should be lowered by cold baths and local refrigerating applications. The patient's strength should be kept up by the administration of alcohol, quinin, strychnin, atropin, digitalis, and strophanthus. Pain and restlessness should be subdued with hypodermatic injections of small doses of morphin. Frank's injections of creasote may be tried. Thierry of Rouen claims to have obtained recovery in ten cases of the most severe septicemia without localization, after having failed with everything else, by means of oil of turpentine injected subcutaneously in gram doses. It forms an abscess, and in one case he produced even so many as three abscesses.³⁹

2. SUBINVOLUTION.

By subinvolution is meant the retardation or arrest of the processes by which the uterus is returned to its normal dimensions, position, and anatomical structure after premature termination of pregnancy or subsequent to delivery at term. This anomaly may also be present in varying degree in the ligaments of the uterus, the vagina, and the abdominal walls. Usually in from six to ten weeks the physiological changes known as *involution* have been completed.

Etiology.—Since the physiological changes in the uterus after delivery are brought about by a diminution in its blood-supply, resulting from contraction and retraction of the uterine muscle-fibres, it is obvious that the causes of failure in involution must be sought for in any factor or factors modifying the amount of blood going to the organ or interfering with its firm contraction. Several conditions may obtain in an individual that operate in either the one or the other manner; indeed, not infrequently the one condition will contribute to retard involution both by increasing the amount of blood in the uterus and by interfering with its contraction.

The most frequent condition interfering with normal involution by determining an excess of blood is a change in the endometrium, which change is

either hypertrophy occurring in the latter months of pregnancy, or an inflammation developing after delivery, the result of septic infection. Very frequently associated with infection is laceration of the cervix or of the perineum with uterine displacement, together with uterine and peri-uterine inflammatory products. Other causes, much less frequent, are polypoid and interstitial or submucous fibroid tumors, and cardiac and hepatic diseases producing engorgement of the pelvic viscera. Later in the process of involution chronic constipation, assuming the erect posture and engaging in exercise or laborious work, and the resumption of sexual intercourse too soon after abortion or after delivery at term, are causes very likely not only to retard, but even to arrest, involution.

The conditions that may cause subinvolution by interference with the contraction of the womb are usually operative shortly after labor, and therefore their early recognition is important. Of these conditions the most important are large masses of hypertrophied decidua, placental polyps, placenta succenturiata, large blood-clots, and displacement of the uterus. The latter, when it occurs within a few days after labor, is commonly due to a misplaced compress and an injudiciously firm abdominal binder, to an over-distended bladder, or to dragging adhesions. In rare cases an extra-uterine tumor may be discovered. Women who from necessity or desire do not nurse their children are more likely to develop subinvolution—a fact which supports the belief of the close nervous connection between the uterus and the mammary glands.

That constitutional disturbances, independent of any local disorder, may influence the course and progress of involution is by no means certain. The older writers were willing to attribute subinvolution very largely to defective nutrition and to the enervating effects of acute and chronic diseases. That such influence is exceptional the writer is forced to believe. At the present writing there is under his care, in the last stages of phthisis, a patient whose physical force is at a minimum, yet involution of the uterus has progressed in a perfectly uninterrupted manner. Analogous cases are repeatedly observed. There are individuals, however, in whom there seems to be a general lack of tone: their muscles are flabby; they are indisposed to take any active exercise, and are frequently of gouty or of rheumatic antecedents. Women of this class sometimes have subinvolution associated later with uterine displacement without a distinct local cause. Nevertheless, it is certainly wiser for the obstetrician to search for a local cause in every case than to be content with attributing a failing involution to any constitutional disorder that may complicate the puerperal period.

Diagnosis.—As subinvolution is the starting-point of numerous intrapelvic disorders, it is important that the obstetrician should recognize its presence, and at an early date begin measures to correct the abnormality, since deferred treatment permits an aggravation of the local changes which occur in the early stages, exposes the patient not infrequently to great danger of infection, and, if the latter is safely passed, renders her very liable to subsequent ill health from intrapelvic disorders.

In the early stages of the process of involution abdominal palpation practised at the daily visit will disclose any cessation in the gradual diminution in the size and height of the womb. For practical purposes it may be stated that the fundus uteri on the day following delivery will be found a finger's breadth above the umbilicus; on the third and fourth days, a trifle below the umbilicus; on the fifth and sixth days, two fingers' breadth below the umbilicus; on the seventh, eighth, and ninth days, three or four fingers' breadth above the symphysis; and on the tenth, eleventh, and twelfth days the fundus is usually slightly above, on a level with, or a little below, the symphysis.⁶⁰ This process of involution continues throughout the puerperal period, and careful intra-uterine measurements taken at varying intervals up to the tenth and twelfth weeks show a steady diminution up to a point when the dimensions of the involuting womb are really less than those of the unimpregnated uterus. Later, the size of the organ by subsequent engorgement of the uterine vessels is permanently increased to a slight degree. Associated with the failure of the uterus to decrease steadily in size there are apt to be an increase in and a prolongation of the bloody lochia, a coated tongue, and constipation. It is thus not a difficult matter to make an early diagnosis of subinvolution; and an early recognition of the condition is of the greatest practical importance.

The diagnosis of subinvolution in its later stage is, unfortunately, too often left to the gynecologist. At this time the uterus is larger than normal and is frequently displaced, usually backward, the os is more patulous than it should be, and the cervix very probably is lacerated. The walls of the uterus are considerably thickened, its vessels and lymphatics are enlarged, and its endometrium has undergone interstitial and glandular hypertrophy. If involution is permanently arrested, connective-tissue development in the muscle-walls soon follows, the changes in the mucous membrane are permanent, and chronic metritis and endometritis are established, to be followed perhaps by periuterine inflammatory disease.

Treatment.—From the foregoing enumeration of the most important causes of subinvolution it is apparent that the proper treatment of each patient will be governed by the cause or causes that may be present retarding normal involution. While the patient is in bed the cause will usually arise from retention within the womb of deciduae or placental masses and blood-clots, or of shreds of the membranes which may or may not be undergoing putrefactive change, but which are always a source of danger and usually require removal. The blood-clots accumulated within the womb can often be removed by stimulating the uterus to contract by gently rubbing the fundus of the uterus several times each day through the abdominal wall, followed by snug application of the pad and binder. When this manœuvre is not followed by prompt reduction in the size of the womb and by diminution of the loss of blood, the cavity of the uterus must be explored with the finger; then, if required, the curette and placental forceps should be used, followed by irrigation with creolin or bichlorid solutions and with boiled water, and the introduction of a strip of sterilized iodoform gauze, which should be removed and may be re-

placed at the end of forty-eight hours. When putrefactive change has begun to take place, which is announced by fetid discharge, rapid pulse, and fever, the necessity for curettage is absolute. Even when fetid discharge is absent the pulse and temperature may be such as to require curettage. The temperature chart (Fig. 423) illustrates the advantage of removing hypertrophied decidua. In

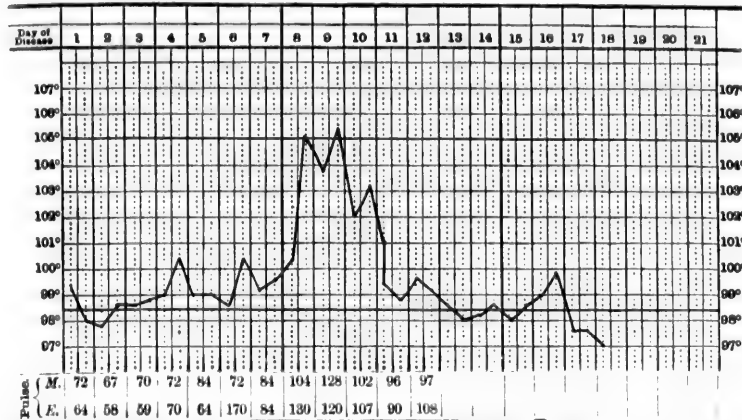


FIG. 423.—Hypertrophied decidua removed with curette and placental forceps on the ninth day; lochia not offensive.

this case the odor of the discharges was not offensive. In the absence of signs of decomposition the dangers of removing foreign material from the interior of the womb are in direct proportion to the obstetrician's ignorance of antiseptic details. It should be remembered that curettage employed against puerperal infection accomplishes the most good when it is resorted to early, and especially after abortion. When infection has spread from the decomposing debris to the uterine wall the operation is less effective, and sometimes does harm by destroying the barrier of exudate which nature supplies to limit septic absorption.

If the womb is displaced, it should be replaced, and attempts should be made to keep it in position by the application of a lateral compress if the displacement is lateral, which is not very rare; by the Sims or the prone position for several hours each day if the displacement is backward; and in all cases by regular evacuation of the bladder and bowel.

When the above treatment has been instituted, or even when there has been no occasion for it, the duty of the obstetrician is always to make a vaginal examination before ceasing his attendance, noting the size and position of the uterus, the condition of the adnexæ, and determining the nature and degree of injuries of the cervix and vagina. If he now finds the uterus displaced, a properly fitted pessary should be applied and carefully watched, smaller sizes being substituted as the involution of the genitalia advances. At the same time it is desirable to deplete the pelvic viscera by copious hot injections, by glycerin tampons, and by free catharsis. Septic processes in or about

the uterus should receive appropriate treatment. Advice may be needed as to the subsequent necessity for reparative operation. The rarer causes of subinvolution—cardiac or hepatic diseases producing venous stasis in the pelvic organs—should not be overlooked. The value of the regular administration of ergot as a means for promoting more rapid involution of the uterus is doubtful. The writer has reserved the use of ergot for those rare cases which seem to be dependent upon either a general lack of muscle-tonus or upon the presence of small and multiple fibroids, in which cases a pill composed of ergotin (gr. j), quinin (gr. ij), and strychnia (gr. $\frac{1}{20}$), administered thrice daily in conjunction with the application of the faradic current, has seemed beneficial. Should, however, the use of ergot impair to any extent the digestion or the milk-secreting functions of the individual, it is best to discontinue its use. Depletion of the pelvic viscera by the employment of copious hot injections, of glycerin tampons, and of free catharsis is also useful in this class of cases. Fibroid and polypoid tumors should be treated as directed in the discussion of *Puerperal Hemorrhages* (p. 604).

When the treatment of subinvolution is first instituted, several weeks after the patient has left her bed, and if she complains of frequent bleeding, leucorrheal discharges, dragging sensations, a feeling of weight and distress in the back and loins, and, finally, is overtaken by the digestive, circulatory, and reflex nervous disturbances of subacute and chronic inflammatory changes in and about the uterus, the case demands most careful gynecological examination and treatment, involving the repair, perhaps, of a lacerated cervix and perineum, the correction of a backward displacement, or treatment directed to the endometrium or to the perimetrium structures.

3. HEMORRHAGES IN THE PUERPERIUM.

Excessive bleeding from the uterus within twenty-four hours after delivery is called "post-partum" hemorrhage. Its causes and treatment have been discussed under *Dystocia* (p. 600). Hemorrhage occurring later than twenty-four hours after delivery is called "puerperal" or "secondary" hemorrhage. The quantity of blood lost during the first eight days of the puerperium has been stated (p. 654) to be three and a quarter pounds. Any excess of this amount should be looked upon as abnormal. The bleeding may vary from a slightly excessive discharge, which is the more common, to a sudden and alarming hemorrhage, which can as quickly be fatal or alarming in its after-effects as the hemorrhage that sometimes occurs immediately after labor. The bloody lochia continuing furnishes a favorable soil for the development and multiplication of micro-organisms, and thus is an additional risk to the puerpera.

When it is noted that the bloody lochia are excessive and prolonged beyond the third day, or when, having ceased at the usual time, there is a return,* investigation should be instituted at once to determine the cause, since the proper treatment of the case usually depends altogether upon accurate deter-

*A return of the bloody lochia for a day or two when the patient first rises from her bed is of common occurrence and of no pathological significance.

mination of the cause. A careful inquiry will necessitate an examination of the uterus, its contents, its position, and of the adjacent structures.

The causes of puerperal secondary hemorrhage, arranged as nearly as may be in the order of their frequency, are :

1. Retained secundines and blood-clots ;
2. Displacement of the uterus ;
3. Displacement of thrombi in the uterine sinuses ;
4. Relaxation of the uterus ;
5. Fibroid or polypoid tumors ;
6. Hematomata ;
7. Pelvic engorgement ;
8. Secondary bleeding ;
9. Malignant disease.

In a series of 3000 deliveries seven cases of severe puerperal hemorrhage were observed. The cause in two cases was over-distention of the bladder, producing uterine displacement ; in one, retained portions of placenta ; in two, the kidney of pregnancy ; and in two cases no cause could be found.

Retained Secundines.—The most frequent cause of hemorrhage in the puerperium is retention of a portion of the secundines, commonly fragments

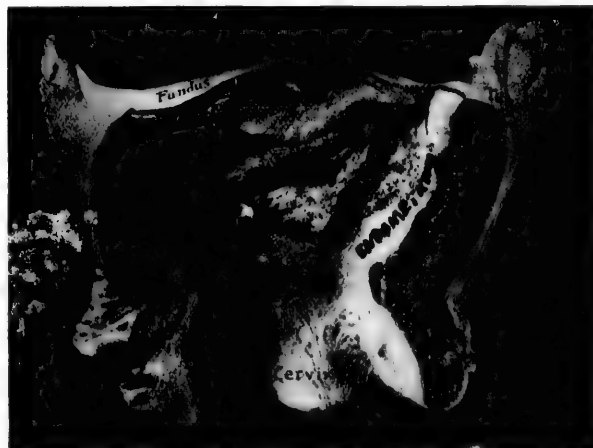


FIG. 424.—Retained hypertrophied decidua.

of placenta, more rarely portions of the membranes. Cases of profuse bleeding from retained secundines are far more frequently observed after abortion or miscarriage than after labor at term. The writer recently removed a piece of healthy placenta from an almost moribund patient who, after a miscarriage, had been bleeding continuously and profusely throughout a period of sixteen weeks. The frequency of retained portions of placenta causing hemorrhage after delivery at term, compared with retention not followed by excessive bleeding, indicates that not infrequently nature successfully disposes of the remnant, in the

absence of infection, by disintegration and drainage. Martin⁶¹ reports nine cases of retained portions of placenta in 2960 births; in six of the nine cases there was not even an excess of the lochia, and in but two was the hemorrhage severe. The frequency of retained membranes is much greater, analysis of various statistics giving a proportion of about 5 per cent. But the frequency and probability of hemorrhage produced thereby are by no means so certain, clinical testimony on this point being at variance. It is reasonable to believe that retention of considerable portions of the membranes favors the accumulation in the uterus of blood-clots which may be of sufficient size to prevent firm contraction, and thus indirectly the retained membranes may be responsible for bleeding, which, however, is seldom profuse enough to endanger life.

When considerable portions of the decidua are retained, whether hypertrophied during pregnancy or after labor, and when to these are added, as is very common, clot-formations of fibrin and blood, an excessive and prolonged lochial discharge is almost certain to result (Fig. 424). Syphilitic endometritis, occurring either during pregnancy or after labor, is a frequent cause of hypertrophied decidua.⁶²

Should a large blood-clot be retained in the uterus, the bloody flow may almost cease, and be replaced by a watery discharge; within a few days there may be a sudden discharge of disintegrated, followed by bright, blood in such large quantity as to cause the patient's death within an hour. A case of this kind has been reported by Parvin.

The so-called "placental and decidual polypoid tumors," having their origin in the puerperium and causing hemorrhage, are really layers of clotted blood or fibrin deposited upon fragments of the secundines or upon a roughened placental site. These fibrin-formations⁶³ may in very rare cases become malignant, as will be pointed out later. Rémy⁶⁴ has recorded an interesting case of inversion of the uterus in the third week due to the efforts of the uterus to expel retained fragments of the placenta.

Diagnosis and Treatment.—Careful management of the third stage of labor always includes an inspection of the placenta and of the membranes, to determine whether any portions of either have been retained in the uterus. When there has been an accessory placental growth—either succenturiata, which has blood-vessel communications with the main placental growth and is therefore functionally active, or spuria, which has no such connection—the diagnosis is, of course, very difficult, and in the latter case is practically impossible. The succenturiate placenta can be diagnosticated by examining the membranes with transmitted light, and observing large vessels passing from the circumference of the main placenta through the membranes and terminating in torn extremities where they have been detached from the accessory growth.

So commonly is puerperal hemorrhage due to retained secundines that it is usually justifiable at once to explore the uterine cavity when the bleeding is profuse; vaginal and abdominal examination will disclose a failure in the normal diminution in size of the uterine body. If the cervix is retracted, which is unusual when the uterus contains material that should have been thrown off,

Hegar's or branched dilators may be employed to open it sufficiently for the introduction of the finger, and by bimanual examination the interior of the uterus should be explored. Fragments of retained secundines may thus be removed, followed by thorough curettage, removal of dislodged particles by placental forceps, and an intra-uterine douche of sublimate solution (1 : 4000), followed by boiled water, or of creolin (2 per cent. solution). When treatment is undertaken after involution has advanced, and the size of the uterus renders the introduction of the finger difficult, the curette and forceps cautiously but thoroughly used will suffice.

Uterine Displacements.—The puerperal uterus may become displaced backward, forward, upward, downward, laterally, or more rarely it may be inverted. From a clinical standpoint it is desirable to consider abnormalities in the position of the uterus according as the symptoms occur *early* or *late* in the puerperium.

The normal position of the uterus immediately after labor is marked anteversion with prolapse, especially of its lower segment. During the first twenty-four hours its retraction elevates the body of the womb to its natural position of anteversion, and the fundus, from the large size of the organ, moves freely about from side to side, rendering a displacement likely of occurrence if the woman is kept lying in one position, or when the bowel or the bladder is permitted to become over-distended, or when a compress and binder have improperly been applied. The result of such displacement is occlusion of the uterine canal by angulation-stenosis, with consequent retention of the lochial discharge and the accumulation of blood-clots, which, if they do not undergo putrefactive changes and expose the patient to the dangers of infection, lead to subinvolution of the womb by mechanically preventing contraction and promoting a passive congestion of the organ. The lochial flow, which at first may have been diminished and very watery, finally, after a few days, reappears, at first very dark, then bright red, and usually profuse, and in rare instances there may be alarming hemorrhage.

The angulation produced by a *flexion* of the womb either forward, backward, or lateral while the patient is yet in bed diminishes the lochial flow until it may almost wholly cease, the blood being retained in the uterine cavity. Very commonly under these circumstances there occur putrefactive changes accompanied by elevated temperature, rapid pulse, and other signs of putrid absorption. Such cases are repeatedly observed, and when, as should always be done, an intra-uterine douche is given, the first introduction of the syringe-nozzle corrects the angulation, and is at once followed by a sudden gush of offensive fluid containing shreds of necrotic decidua and blood-clots. The displacement interferes also with involution, as previously stated, and favors the retention and hypertrophy of decidua; hence the irrigation should always be followed by curettage. Cases which escape infection, but ultimately lead to engorgement of the pelvic and uterine vessels, are followed by bleeding more or less profuse. Usually the flow is moderate but persistent, and after a time the patient is reduced in strength. Occasionally a sudden and

alarming loss of blood will occur. In addition to exploration of the uterine cavity, the condition of the bowel and the bladder should receive attention, and by the careful adjustment of a properly-placed pad and binder the displacement can often be corrected. The displacement caused by an over-distended bladder is almost invariably upward and to the right. The nurse should receive minute instructions as to the manner of adjusting the pad, and when the displacement is lateral she should be taught to press the uterus toward the median line and to reapply the pad several times each day.

Inversion of the puerperal uterus usually occurs immediately or soon after labor, but it may occur during the puerperium, even so late as the third week, as happened in the case reported by Rémy.⁶⁵

The *cause* of this rare accident may be severe straining at stool, or efforts of the womb to expel a foreign body, such as a polypoid tumor or a large piece of placenta. The *diagnosis* and *treatment* of inversion of the uterus have been discussed (pp. 619-623). It remains only to be stated here that when this accident first occurs several days after delivery, it should be borne in mind that the inverted uterus is especially likely to be mistaken for a polypoid tumor, from which it is readily diagnosed by bimanual and rectal examination and by an attempt to pass a uterine sound. Other conditions to be remembered, which under some circumstances simulate an inverted uterus, are hematoma of the vulva, of the vagina, or of the cervix, prolapse of the uterus, and possibly vaginal enterocele.

Displacement of the uterus at a later period of the puerperium is usually *retroflexion* or *retroversion* (Pl. 43), with varying degrees of prolapse.

The *cause* of the displacement is almost invariably subinvolution, not only of the uterus, but also of its ligaments and of the vagina. The injury of the vagina which contributes to the displacement is a neglected laceration of the pelvic fascia and the levatores ani muscles. In very rare cases, when these injuries have been very severe and the entire attachment of the vagina has been severed, premature getting up and prolonged straining at stool or the lifting of heavy weights have caused complete *prolapse* of the puerperal uterus. The *treatment* of such displacements belongs to gynecology and comprises curetting and packing the uterus with gauze, followed by plastic operations on the vagina, or one of the operations devised for suspending or fixing the uterus in its normal position.

Separation or Disintegration of Thrombi in the Sinuses at the Placental Site.—Alarming hemorrhage may follow either of these accidents even so late as two or three weeks after delivery. Separation may occur when the patient is permitted to assume an upright posture or is allowed to get out of bed soon after labor. After the third day this danger would appear very slight, since in several thousand cases at the Preston Retreat, Philadelphia, where it has been customary for the nurse to help the patient to the commode rolled to the bedside, no such accident has been recorded.

Disintegration of clots leading to dangerous hemorrhage sometimes accompanies puerperal infection which has produced necrotic changes in the thrombi.

Hemorrhage may occur spontaneously in these cases, and it has been observed in the course of treatment when the cavity of the womb is curetted. When alarming bleeding occurs soon after delivery and the uterus is found empty, dislodgement of thrombi should be suspected, and the bleeding should be controlled by an intra-uterine tampon of iodoform gauze. The same treatment is applicable to hemorrhage from disintegration of thrombi.

Relaxation of the Uterus.—Hemorrhage from this cause, and of severe type, may rarely occur within the first three days after labor. It may be a sudden outpouring of blood, or, the cervix being obstructed by a clot, the blood may accumulate in the uterus, in which case the patient's condition of faintness and the pain caused by the over-distention of the uterus may be the only signs of the accident until the size of the uterus is ascertained by palpation. Bleeding so sudden and alarming as this is invariably due to relaxation of the uterus. This accident, which is of rare occurrence, is usually found in women of lowered vitality and muscular weakness. One case of the writer's, occurring forty-eight hours after labor, was doubtless due to the exhaustion and relaxation following vigorous purgation and the free use of chloral and veratrum in the treatment of violent eclamptic attacks during labor. In two other cases the hemorrhage occurred ten and twelve hours respectively after the delivery of twins. Sudden and profound emotion has been followed by profuse hemorrhage, probably the result of relaxation, although alteration in blood-pressure has been claimed to produce it. Hemorrhage due to relaxation of the womb should be treated promptly by emptying the womb by expression or by the introduction of the hand, followed by the usual means of controlling bleeding immediately after labor, resorting, if need be, to the employment of an intra-uterine iodoform-gauze tampon.

Fibroids.—The dangers of uterine fibroid tumors complicating the puerperium are twofold. The greater danger is the possibility of the tumor undergoing necrotic change and septic absorption from the sudden diminution of its blood-supply during the processes of involution of the uterus. The lesser danger, yet one of great importance, is the hemorrhage it may occasion, rarely profuse, but usually sufficiently prolonged to impair seriously the patient's strength and health. Hemorrhage is very prone to occur when the tumor is submucous or pedunculated. Interstitial and subperitoneal tumors may not be productive of hemorrhage, but they may undergo the sloughing change just referred to, and, besides, may so thin the uterine wall as to add the risk of perforation when the uterine cavity is being explored by the curette or other instrument.

The diagnosis of fibroid tumors in the puerperal uterus can be made by intra-uterine and bimanual examination. If, when a tumor is discovered, hemorrhage is the only complication present, it may be controlled temporarily, if not profuse, by the daily use of ergot, strychnia, hydrastis, and the faradic current. Should the tumor be polypoid, it is best to remove it by the wire cæraseur and scissors. If sloughing has occurred, which is announced by a foul discharge, this treatment, or removal of the tumor by the blunt curette, care

being taken not to perforate the uterine wall, or hysterectomy, is imperative. Should interstitial or subperitoneal tumors become necrotic and threaten sepsis, hysterectomy is indicated.

Hematoma.—Hematoma in the puerperium has been discussed on page 680.

Pelvic Congestion.—Pelvic congestion from any cause may occasion hemorrhage of varying severity in the puerperium. The increased blood-supply to the pelvic organs and the return for a few days of the bloody lochia when the puerperal woman first rises from her bed constitute a frequent and physiological example of the occurrence of pelvic congestion. When the bleeding is prolonged beyond a few days, a pathological condition should be looked for in subinvolution with uterine displacement, in periuterine inflammation, or in a too early resumption of, or desire for, sexual intercourse. Occasionally other causes may be discovered, such as an accumulation of fecal masses in the rectum, an intrapelvic tumor, or disease of the liver, kidneys, or heart.

Secondary Bleeding.—Rare cases have been recorded of rupture of an artery or a vein by erosion, and of hematomata and secondary hemorrhage following lacerations, in which cases the bleeding was controlled temporarily by the pressure of the child's head during labor. In such cases the bleeding vessel should, if possible, be found and ligated; otherwise a firm antiseptic tampon is the only recourse.

Hemorrhage from malignant disease is of rare occurrence, since malignant diseases of the uterus, either carcinoma or sarcoma, usually prevent conception. Digital examination will at once make the diagnosis of malignant disease of the cervix, and the hemorrhage may be controlled by a vaginal tampon frequently renewed until the advisability of hysterectomy has been considered.

Cancer within the body of the womb complicating the puerperium is also rare. Whether in most cases the disease exists prior to impregnation, as insisted upon by Veit, or whether it develops after labor, either at the placental site or in the decidua, is not by any means certain. In either case death ensues within a few weeks or months. Müller⁶⁶ found, in an analysis of 577 cases of carcinoma of the uterus treated in Gusserow's clinic, that in 8.14 per cent. the disease developed during pregnancy or the puerperium. Cases of malignant disease developed at the placental site have been reported by Chiari,⁶⁷ Kuchler,⁶⁸ and others. Von Kahlden⁶⁹ described a case of malignant degeneration of a placental polyp in which case death occurred eleven weeks after delivery.

Gottschalk⁷⁰ reviews 10 cases of malignant deciduoma, of which eight had previously been reported, and he records a case (a VI-para æt. forty-two) in which, the recurring hemorrhages not being relieved by repeated curettage, he dilated the cervix and examined microscopically the scrapings from the placental site. Sarcomatous new growths of the fimbriæ of the placenta were found. Although the patient's general condition was bad and her temperature was 104½° F., the uterus and ovaries were removed eight weeks after delivery, and recovery followed. Bacon⁷¹ described in detail a case of deciduoma malig-

num, and gives a table of all the cases reported, fifteen in number, of tumors composed of elements derived from decidual cells, and five cases of tumors composed of elements derived from chorionic villi. He points out the important clinical fact that half of the cases followed molar pregnancy, and in support of the notion that the tumors began during pregnancy he states that in twelve out of 18 cases the hemorrhage was known to have appeared almost immediately after labor or abortion. As to prognosis, he says, "All cases have terminated fatally except two which have been reported this year. In one of these cases, that of Nové-Josserand, the uterus has been removed. In three previous cases this operation was done in vain. The other non-fatal case was Menge's patient, who received a simple curettement of the uterus. The further report of this case will be of special interest."

When continued hemorrhages are not relieved by the curette and are not traceable to constitutional disturbances or to other evident local causes, the possibility of malignant disease should be thought of, and the scrapings should be subjected to critical microscopical analysis. The result of malignant disease of the puerperal uterus in the reported cases has, with one exception, been a rapidly fatal termination, except when the uterus was wholly removed. This fact points to extirpation as being the only rational treatment when a positive diagnosis of malignancy has been made sufficiently early. Should the hemorrhage meanwhile be profuse and alarming, the intra-uterine gauze-tampon may be employed.

Among other conditions very rarely causing puerperal hemorrhage should be included profound emotion, syphilis, chlorosis, scurvy, nephritis, and malaria. Hemorrhage due to either of the blood-dyscrasias is probably the result of changes in the blood preventing the formation of obliterating coagula (Cazeaux).

There is yet some difference of opinion as to malaria being a factor in puerperal bleeding. Billon in his inaugural thesis (Paris, 1883) denies any such influence after carefully analyzing 90 cases. Liègeois, however,⁷² describes such a case, and the writer recently observed a case of free bleeding apparently due to this cause. It has been pointed out by Winckel⁷³ that free bleeding often follows the determination of blood to the internal organs by a chill, which fact may explain the hemorrhage observed in some cases of malaria.

4. ANOMALIES OF THE NIPPLES AND THE BREASTS.

The anomalies of the nipples are of clinical importance by reason of their relation to inflammation of the breast during lactation. In ninety-seven cases of puerperal mastitis Birket⁷⁴ found imperfect development of the nipples in forty-eight.

Athelia, or absence of the nipple, is sometimes congenital; it may be the result of traumatism or of suppuration of the breast in the new-born infant.

Microthelia is the name given to small, ill-developed, or sunken nipples. Microthelia is by no means uncommon; it may be the result of a congenital

defect, or the condition may be acquired from the wearing of faulty clothing or of corsets compressing the breasts and flattening or even invaginating the nipples. The accompanying illustration (Fig. 425) shows diagrammatically

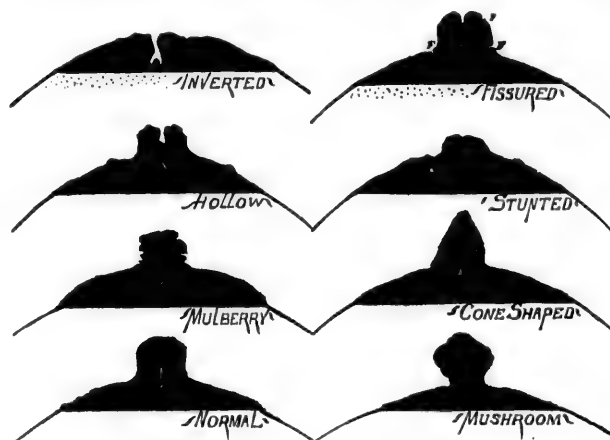


FIG. 425.—Faulty development of the nipple.

several varieties of badly-shaped and ill-developed nipples which interfere with suckling. The sunken or invaginated nipple cannot readily be grasped by the infant's mouth, and the insufficient flow of milk aggravates the child and leads to vigorous biting and tugging, which are soon followed by erosion or fissures of the nipple. When the infant takes the mushroom-shaped nipple into its mouth the narrow base of the attachment of the nipple to the breast is further occluded and thus a free flow of milk is prevented, and traumatism of the nipple follows the increased efforts of the child. The treatment of microthelia will be referred to later.

Polythelia.—In polythelia—supernumerary nipples—the multiple nipples are usually found in a line running downward and inward or upward and outward, analogous to the situation of the nipples in the lower animals. Bruce⁷⁵ found supernumerary nipples relatively frequent among women—4.8 per cent. in 104 women.

Amazia, or congenital absence of one or of both breasts, is an extremely rare anomaly. According to Delbert, the absence of one breast has been observed only in women, and the absence of both breasts occurs only in monsters having usually other deformities incompatible with life.

Micromazia, or small breast, which is a defect very much more frequent than amazia, is sometimes associated with an infantile uterus.

Polymazia, or supernumerary mammary glands, is an anomaly more frequent than amazia. The multiple breasts may vary from a small nodule of glandular tissue to a fully-developed breast capable of nourishing an infant. Although sometimes situated in the axilla, on the back, or on the thigh, the glands are commonly seated upon the anterior wall of the chest.



DISEASES OF THE NIPPLE: Erosion of the nipple (from a photograph)



5. DISEASE OF THE NIPPLES.

Sore Nipples.—Under the term "sore nipples" is usually described a group of inflammatory conditions of the nipple varying in severity from a simple yet painful erythema to erosions, ulcers, and fissures that may occasion so great distress as absolutely to contra-indicate nursing. Clinically, sore nipples are of the greatest importance on account of their close relation to mastitis and mammary abscess. When the irritation of the nipple passes beyond simple erythema, the epithelium is denuded at one or more points, leaving the underlying papillæ unprotected. Within a few hours there is likely to appear an erosion (Pl. 47) situated most often upon the apex of the nipple, next in frequency upon the sides, and least frequently at the base of the nipple. If at this time proper curative treatment is neglected, the erosions are often converted into fissures.

When the natural divisions between the papillæ at the summit of the nipple are deeper, broader, and larger than normal, the removal of the overlying epithelium by the lips and tongue of the child in the act of sucking leaves deep fissures which are very troublesome, cause intense pain, and often bleed at each nursing. Fissures situated at the base of the nipple, at the junction of the nipple and the areola, are usually semilunar in shape; they are often the most difficult to heal, because the act of sucking almost always separates their edges, and thus at each repeated nursing they grow deeper and extend more and more around the nipple, sometimes even penetrating a milk-duct and leaving a milk-fistula. Rarely the nipple is thus partially, or even wholly, amputated.

The frequency of fissures of the nipple is estimated by Kehrer as 44 per cent. in primiparæ, in whom sore nipples are certainly more frequent than in multiparæ. Hübner states that 51 per cent. of nursing mothers between the third and the fifth day will have fissured nipples. Winckel found seventy-two among 150 nurses. Dluski⁷⁶ found one hundred and eighty-one cases, ninety-nine being slight, in 433 recently-confined women in Baudelocque's clinic. Women with delicate skin, particularly blondes, are more liable to have sore nipples. The frequency, certainly of severe cases, is doubtless in some measure dependent upon the degree of cleanliness and care of the nipples in the early days of lactation.

Etiology.—The anatomical structure of the nipple, particularly when there are developmental defects, predisposes the organ to inflammation, on account of the injury it is likely to receive during the act of sucking. The delicate epithelium covering of the nipple, being softened and macerated in the child's mouth, is then readily removed at various points, leaving the papillæ unprotected and bathed with milk and often with blood, both of which are excellent media for the growth and development of micro-organisms. When the nipples are misshapen, short, or inverted (Fig. 425), the infant is unable readily to grasp the nipple with its mouth, and efforts at sucking are consequently more violent and the traumatism to the nipple are thereby correspondingly increased. While some authors consider the traumatism of sucking the

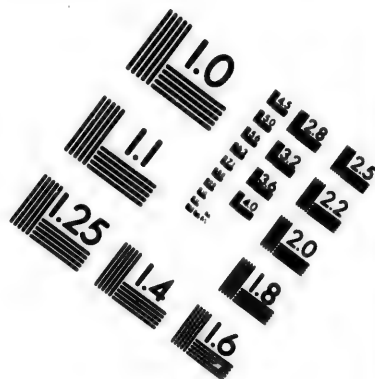
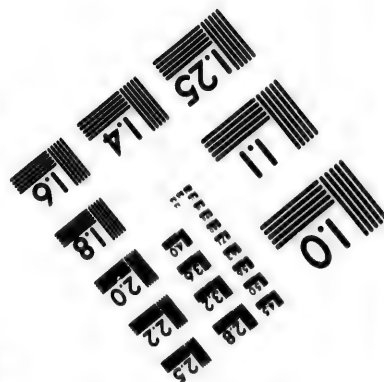
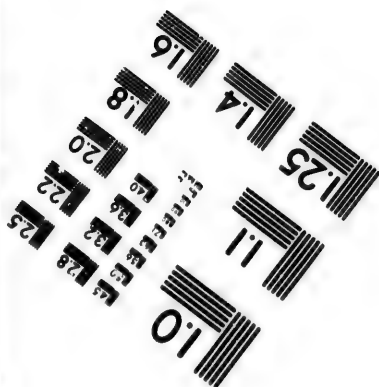
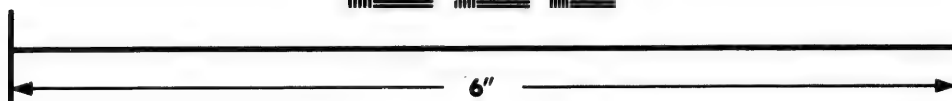
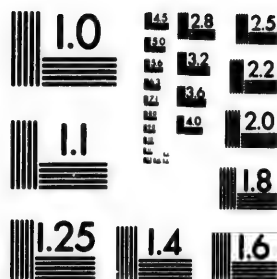


IMAGE EVALUATION TEST TARGET (MT-3)



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most important element in the etiology of sore nipples, others lay most stress upon bacterial invasion from the nurse's or the mother's fingers, from soiled cloths, and often from the child's mouth. The truth doubtless lies, as is so often the case, in the middle ground. The trauma lessens the resistance of the nipple-structures to invasion by micro-organisms, and when scrupulous cleanliness of both the nipple and the infant's mouth is neglected a slight irritation becomes an infected wound. Bumm⁷⁷ frequently found in fissured nipples bacilli and cocci, and even the staphylococcus aureus and albus, when there was no adjacent inflammation.

Symptoms.—From the third to the fifth day of the puerperium the ulceration at some point of the nipple usually appears, accompanied by very severe pain, and in nervous individuals easily responding to reflex irritation, or when the sore is infected, the temperature may rise as high as 104° F. or higher, and may even be accompanied by convulsive movements. The nervous irritation and the apprehension of the excruciating pain occasioned by nursing sometimes prevents sleep and seriously interferes with the appetite and digestion.

Treatment.—The prophylaxis should begin in the latter months of pregnancy. Pressure upon the nipples by corsets and by clothing must be avoided. The nipples should be washed morning and evening with a bland soap and water, followed by innunction with cacao-butter, lanolin, or sweet oil, and once each day they should be treated with a saturated solution of alum or with a 50 per cent. solution of glycerol of tannin. When the latter is used the patient's underclothing should be protected from being soiled by the tannin. If the nipple is invaginated, attempts may be made to draw it out with the fingers, or, what is more effective, by buccal suction or by the application over the nipple of the mouth of a bottle just emptied of hot water. These manipulations are to be employed only in the last months of pregnancy, since they can cause premature termination of pregnancy. Layers of adhesive plaster around the nipple, 4 centimeters (1½ inches) in width and 13 millimeters (½ inch) thick, may be worn some months before labor. When these measures fail, if the malformation and shortness of the nipple are not too great, and if it is especially urgent that the mother should nurse her child, the operation of mammillaplasty, first suggested by Kehrer, will improve the defect. Williams⁷⁸ thus describes the operation: "A circular strip of skin, together with the subjacent fibro-fatty tissue, is excised from the prominent cutaneous fold surrounding the depressed nipple; or, instead of a circular strip, two crescentic pieces may be removed (Kehrer). Care should be taken to avoid injuring the subjacent ducts; this will be rendered almost impossible by keeping the incisions external to the areola. On suturing together the opposite cut edges of the mammillary and mammary skin the nipple will be pulled into its proper position. In a case reported by Herman⁷⁹ the operation resulted in a permanent cure. Of course, not much good can be expected from this proceeding when the nipple is congenitally stunted and malformed."

From the earliest period of lactation close attention to cleanliness of the nipple and of the child's mouth is of the greatest importance. At least once a

day, preferably oftener, the child's mouth should be washed with a saturated solution of boric acid or of borax. Before and after each nursing, which should be at regular intervals, the nipples are to be washed gently but thoroughly with absorbent cotton and the boric-acid solution and carefully dried. If the epithelium is at all inflamed, the nipples, after nursing, should be covered with a protective ointment. For this purpose either of the following ointments, spread upon a clean piece of lint or waxed paper, will be useful:

R̄. *Acidi borici*, gr. xx;
Olei ricini,
Bismuthi subnitrat̄is, āā ʒij.

Or,

R̄. *Tincturæ benzoini compositāe*, gr. xv;
Olei olivæ, ʒij;
Lanolin, ʒvj.⁸⁰

Or the nipple may be covered with lint wet with dilute lead-water—a plan having the disadvantage of necessitating thorough washing from the nipple of every trace of the lead lotion before the child nurses. The distilled extract of witch-hazel diluted with three or four parts of water the writer has found especially useful, alternating this lotion with the bismuth paste.

When the epithelium is eroded at several points or in one large area, following the same precautionary cleansing before and after nursing, the ointments above referred to, or either of the following, may be used: Iodoform, gr. x; oxide-of-zinc ointment, ʒss; or, Ichthyol, ʒj; lanolin and glycerin, āā ʒiiss; olive oil, ʒiiss. The compound tincture of benzoin, or a 10-grain solution of silver nitrate, painted on with a brush, will sometimes be useful. Powdered tannic acid dusted over the raw surface, and kept in place by a small circular piece of lint smeared with cosmolin, is highly praised by Garrigues.⁸¹

For a distinct and deep fissure, whether situated at the apex or the base of the nipple, the solid stick of nitrate of silver, applied carefully and only to the fissure, is perhaps the most efficient treatment. This application may often with advantage be followed a day later by careful coaptation of the surfaces of the fissure by pressure with the fingers, the coaptation being thus maintained until the fissure is permanently held together by a few drops of collodion and a thin film of absorbent cotton.

While one or more of these local applications are being carried out it is always desirable to resort to a mammary binder (see Fig. 429, p. 753) and to relieve somewhat the mother's pain and prevent further injury to the nipple by using a nipple-shield. Of the numerous varieties of shields, that figured in the illustration (Fig. 427)—a glass bell with a soft-rubber nipple—is most useful. The shield should always be taken apart after nursing, be cleansed thoroughly, and be kept immersed in a tumbler containing boric-acid solution. It is desirable also occasionally to wash the shield in a 5 per cent. carbolic solution or to boil the glass bell for twenty minutes. Persistence on the part of both nurse and mother will often overcome the child's aversion to a shield, particularly if the

glass bell of the shield is tightly applied to the areola and partially filled with milk by stroking the breast before the rubber nipple is placed in the child's

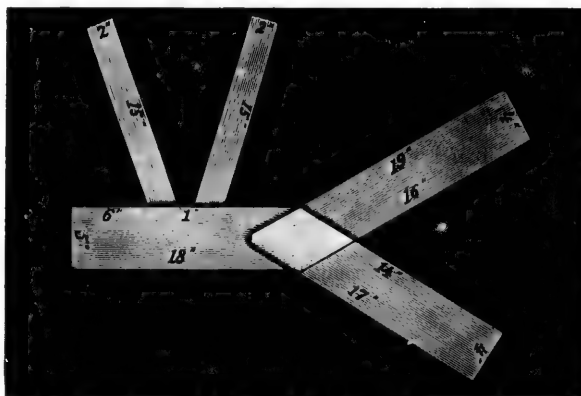


FIG. 426.—The Y-bandage (Boston Lying-In Hospital).

mouth. If the shield can be used, much has been gained toward the prevention of more serious trouble in the breasts by thus avoiding congestion and engorgement of the glands—an accident not unlikely to occur if the extreme pain of suckling makes it necessary to give up nursing, and if at the same



FIG. 427.—Nipple-shield.

time the nurse is not skilled in preventing mammary engorgement by massage (Pl. 48), a measure, when the manipulations are skilfully performed, vastly superior to the breast-pump. The nipple-shield, however, should not be used in case the fissure is so situated that the action of the shield is observed to aggravate the condition by pulling open the fissure, thus failing to relieve the mother's pain each time the child sucks. Fissures located at the base of the nipple will sometimes be aggravated by the shield. The shield should be given up at the earliest possible moment after the nipple has healed.

Sometimes it will be necessary for a few days to remove the child wholly from the nursing breast. Usually twenty-four hours will be sufficient to allow the fissures to heal under appropriate treatment, but in severe cases, when mammary inflammation is threatened, three or four days may be required. Meanwhile massage and other means to prevent mastitis are to be employed. In very exceptional cases nothing short of artificial feeding and drying up of the breasts will give permanent relief—a defeat not to be permitted except in the presence of an imminent mammary abscess or when the epithelium of the patient's mammary glands and the nipples have proved, on the one hand, unequal to a sufficient supply of milk, and thereby, on the other hand, incapable of tolerating the more active biting and tugging of the infant at the nipple, which efforts continue to destroy its epithelial covering.

Abscess of the Nipple.—There has been described⁸² a deep inflammation of the nipples that undergoes resolution or, more often, results in the formation of a small abscess either in the lactiferous ducts or in the connective tissue of the nipple. This affection is a very rare one. If pus forms in the ducts, it is evacuated spontaneously through the apertures of the ducts; if the abscess is confined to the connective tissue, the nipple enlarges, and becomes very red and tender, which changes are often soon followed by a spontaneous opening; when the opening is delayed an incision should be made on the circumference of the nipple, after which there is rapid healing. Lactation should be interrupted for a few days until there is no longer a trace of pus.

Eczema.—Eczematous affections of the nipple and the areola sometimes spread to the adjacent integument of the breast; these affections are often difficult to cure, weaning being necessary in some stubborn cases. Stumpf,⁸³ who has thrown the light of bacteriology upon the clinical fact that eczema of the nipple sometimes leads to mammary abscess, demonstrated the presence in eczema of the breast and nipple of a staphylococcus, probably *pyogenes aureus*; he found the same micro-organism in the milk of those affected, and he believes that the reinfection thus occurring explains the stubborn character of the disease.

Treatment.—Protective ointments containing zinc, salicylic acid, or carbolic acid are useful in some cases; in other cases more active remedies, such as resorcin, nitrate of silver, or corrosive sublimate, should be employed, care being taken always to wash the nipple thoroughly before nursing.

The breast is sometimes affected with *scabies*, and occasionally with *herpes zoster*. *Syphilitic ulcers* should be recognized promptly, and should receive local and constitutional specific treatment. When the child presents no evidence of syphilis weaning is imperative.

6. DISEASES OF THE BREASTS.

Congestion and Engorgement of the Mammary Glands.—At the first appearance of the flow of milk, and thereafter throughout the lactation period, especially during the first two weeks, it is not uncommon suddenly to find the



FIG. 428.—Breast-pump.

breasts engorged with milk, accompanied sometimes by pain and tenderness and a slight rise in temperature; or the reaction may be so slight as to occasion

only distress and a sense of fullness of the mammary glands. Hypersecretion of milk and exposure to cold are commonly the causes of this condition, which is promptly relieved by removing the excessive amount of milk in the breast and by preventing further engorgement. The over-distention of the gland is relieved by more frequent application of the infant to the breast, by massage, or by the breast-pump. Of the various breast-pumps offered in the shops, that called the "English" (Fig. 428) is the most desirable and efficient. Further engorgement will be prevented by the administration of one or two full doses of a saline purge to obtain free catharsis, and by compression of the breasts with a mammary binder.

Support and Compression of the Breasts.—Various means have been devised for obtaining compression of the breasts. Strapping with strips of adhesive plaster, the roller bandage, painting the breasts with contractile collodion, and the various types of mammary binders are means each of which has its champions. As a matter of fact, with the exception of adhesive plaster, with which it is not easy to obtain persistent uniform compression, and which is troublesome on account of the painful excoriations of the skin produced, each of these means is specially useful under certain circumstances, and each, therefore, has its special indications. It is the writer's custom in both hospital and private practice to apply a mammary binder to every puerperal patient when the milk-flow is beginning to be established. At this time support, not compression, of the breasts is desired. For this purpose the Murphy binder (see Fig. 412, and description, page 662) is ordinarily used, because of its simplicity, efficiency, and ready manufacture. When, however, the nipples are stunted or otherwise ill-developed, the Murphy binder has the disadvantage of aggravating the defect by firmly compressing the nipple against the breast, and by increasing the heat and moisture of the nipples, both of which effects render sore nipples more liable of occurrence. To escape these disadvantages the writer has some of these bandages made with an opening about the size of a silver half-dollar over each nipple (Fig. 429). The margins of the openings are button-hole stitched. This modified bandage is used when the nipples are stunted or are inverted or when it is necessary to make applications to eroded nipples—such, for example, as the bismuth paste or the witch-hazel lotion. The nipple, after being cleansed, is smeared with the paste, and a disk of clean waxed paper with a film of the paste at its centre is placed over the nipple, after which the bandage is applied. The infant may now be nursed, or repeated applications of a lotion may be made, without loosening the bandage. Should the nipple and the areola show any evidences of edema, which will sometimes happen when the bandage is too tightly applied, the swelling will be relieved by loosening the bandage and, if necessary, by pinning over each opening a strip of muslin only slightly compressing the nipple.

When it is desired to compress the breasts firmly, as in threatened mastitis and after massage, a straight strip of unbleached muslin tightly encircling the chest over the breasts, or the Y-bandage (Boston Lying-in Hospital), is preferred (Fig. 426). The latter is applied as indicated in Figure 430.

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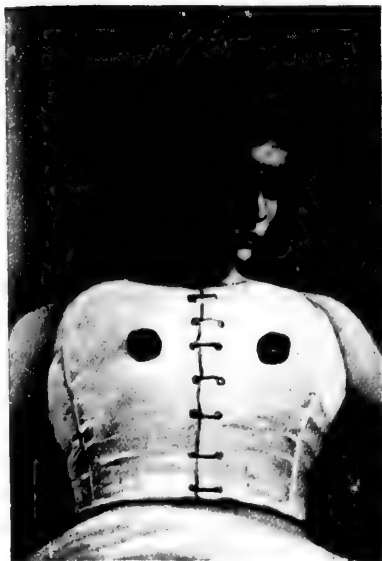


FIG. 429.—Modified Murphy breast-binder.

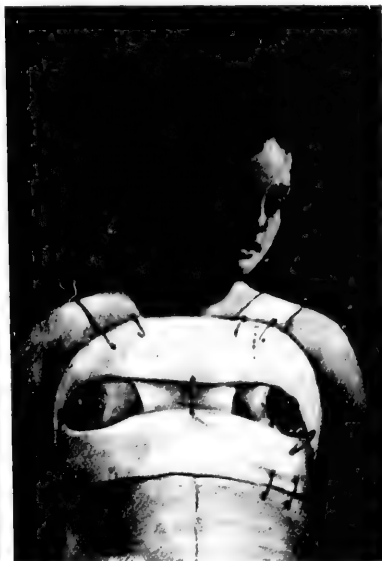


FIG. 430.—The Y-bandage (Boston Lying-in Hospital).



FIG. 431.—Roller bandage applied to both breasts.

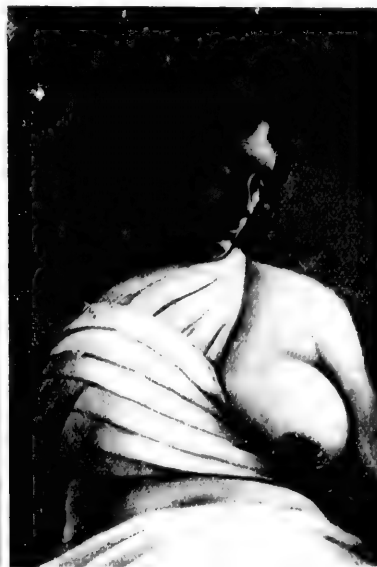


FIG. 432.—Roller bandage applied to one breast.

After dusting the surface of the breast with powdered starch or other bland dusting-powder, the base of the Y is drawn beneath the patient's back until the apex of the fork is external to the outer edge of the breast. The patient now lifts upward and toward each other the two breasts, and the lower arm of the fork is snugly drawn across the chest beneath the breasts, the inferior border of this arm extending at least an inch below the margin of the glandular tissue. The free end of the arm is now pinned to the free end of the strip that has passed beneath the back, and the inferior border is prevented from slipping upward by two safety-pins attaching it to the abdominal binder. The upper arm of the fork is then drawn across the chest above the breasts, the upper border of this arm extending an inch beyond the glandular tissue of the breast, and the free end of the arm is pinned to the end of the strip passing behind the back. The upper border of this arm is prevented from slipping by pinning it to the shoulder-straps. To secure smoothness of the bandage and uniform pressure of the breasts, safety-pins are now applied where the two arms of the bandage join each other under the axillæ; the pinning should be from the axilla toward the areola in order to decrease the pressure of the bandage gradually as the nipple is approached. A folded towel covered with a layer of absorbent cotton is now placed between the breasts to exert pressure upon their inner surfaces, and the two arms of the bandage are brought together and fastened between the breasts by means of a safety-pin. This bandage, when properly applied, should exert so much compression of the breasts that milk soon begins to flow from the nipple. The bandage will therefore occasion considerable pain, making it necessary to loosen it after a few hours. It should be worn for several days, with a degree of compression only short of producing pain. After all signs of inflammation have subsided the Murphy binder may be substituted.

Ordinarily the two bandages just described will serve the purpose of support or of compression of the breasts. When, however, it is desired permanently to discontinue lactation, and to dry up the breasts when abscess is threatened, the degree of compression needed is best obtained by a tight roller bandage (Figs. 431, 432) or, what is even more efficient, though very painful, by a dressing of contractile collodion. A circular piece of material sold in the shops under the name of "silk illusion" is applied to the breast, and should extend 2 or 3 inches beyond its periphery, with a central opening for the nipple and areola. To prevent puckering and to secure close adaptation to the contour of the breast, the material is cut at intervals of an inch or more from the periphery toward and halfway to the central opening. The breast is smoothly covered with the circular piece of illusion thus prepared, and a thin layer of collodion is applied and allowed to dry. Successive layers of collodion will give any amount of compression desired. Notwithstanding every precaution a circle of blisters around the periphery of the dressing is likely to occur. This disadvantage, and the possible necessity of releasing the breast temporarily for practising massage when compression fails to drain the breast, make the collodion dressing of doubtful utility. A very firmly



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Massage of the breast (from photographs).



applied Y-bandage or the roller bandage is almost as efficient and certainly is less troublesome and less painful.

Massage of the Breasts.—To achieve the best results from manipulation of the breasts it is necessary to know its limitations as well as its indications, and more important than all is an intimate knowledge of its technique. The physician should give the matter his personal attention when there is not at hand a nurse upon whom he can rely for its proper performance. The important contra-indication to breast-massage is interstitial inflammation of the breasts. It is a method of treatment of great value for the relief of pain and tension in the breasts, due to engorgement with milk when the infant fails to empty the breast properly, especially when the nipple is sore. Breast-massage is also useful in mastitis to empty the gland-acini of their contents, and even of pus in the early stage of parenchymatous abscess; thus it has often saved the anxiety, pain, and sequelæ of lancing such an abscess.

Technique of Breast-massage.—After cleansing the breast the entire skin-surface of the breast is anointed with a lubricant, preferably with camphorated or carbolized oil. It is the writer's practice either himself to perform or to teach his nurse *four* distinct manipulations. The first manipulation is one of gentle and quickly-repeated strokes of the finger-tips (Pl. 48, Fig. 1). The breast can conveniently be supported during the manipulation by the patient placing her forearm under the breast, drawing the breast upward, and supporting it. Starting at the periphery of the gland, the fingers are separated, and are brought together as the tips of the fingers terminate the stroke at the nipple. Each segment of the gland should thus be rapidly stroked in succession, paying particular attention to the region of the nipple, and, short of producing much pain, the pressure of the finger-tips should gradually be increased.

After this manipulation has been practised for about five minutes and pain is no longer experienced, the operator supports the breast in the palm of one hand placed under the indurated spot, and with the fingers of the other hand this spot is again stroked toward the nipple, using deeper and firmer pressure (Pl. 48, Fig. 2). Each nodule of induration is thus treated in succession.

The palm of the hand is next placed flat upon the inflamed portion of the breast (Pl. 48, Fig. 3), and is then slightly inclined toward the periphery of the breast; steady and gentle pressure is now made downward against the chest-wall, the pressure being greater under the outer margin of the hand—that is, at the periphery of the gland. After a few moments of steady pressure gentle rotary movements of the hand are practised over the lump. Pressure and rotation of the hand are thus alternated for a few minutes or until the patient complains of pain, when the stroking movements (Pl. 48, Fig. 1) are renewed for a short time.

Finally, the breast is grasped firmly with both hands in such a manner as to encircle the breast completely (Pl. 48, Fig. 4); the whole gland is gently raised from the chest and compressed, especially over and at the base of the indurated nodule, and at the same time the two index fingers are quickly stroked

toward the nipple, when milk is usually seen to flow from the ducts that empty that portion of the gland. The pressure is not relaxed, so long as the milk flows, until the patient complains of the pain it commonly occasions in a few minutes. After a few moments of rest and reassurance to the patient the manipulations are repeated in the order above described until the whole gland is soft and flaccid, when a pressure-bandage, preferably the Y-bandage, is snugly applied.

Mastitis.—Frequency.—It has been estimated that about one-fourth of all fertile married women have suffered from inflammation of the breast at some period of their reproductive activity, and in 1000 consecutive deliveries Winekel⁸⁴ observed mastitis in 6 per cent. of the patients. This percentage undoubtedly exceeds the number of cases observed under the more rigid attention in recent years to antisepsis of the nipples and breasts. Deiss⁸⁵ records a frequency of 3.6 per cent. in 1600 consecutive confinements. The disease is more frequent in primiparæ. It is said to be observed oftenest in blondes and in lymphatic subjects. It is rare after the fourth pregnancy (Delbert). There are four periods of the puerperium in which mastitis is most likely to occur. These periods are: (a) the first month of the puerperium (especially the first two weeks), while both the mother's nipples and breasts and the infant are adapting themselves to the mammary function; (b) when suckling is suddenly given up, thus favoring stasis and its ill effects; (c) the period of appearance of the first teeth, at which time the nipple is again exposed to injury; (d) and the time of weaning, when either engorgement of the gland is likely to occur because the regular emptying of the breast is not attended to, or, as happens especially in hyperlactation, the child, not being satisfied with the quality and quantity of milk secreted, shows its dissatisfaction by biting and tugging at the nipple.

Varieties.—It is customary to describe three varieties of mastitis, according to the location of the inflamed area. The first and most frequent variety is the *parenchymatous* or *glandular*, in which the acini of the gland or the adjacent connective tissue is primarily attacked by inflammation (Fig. 433). In either case the destructive inflammation, as it progresses, may end by involvement of both the acini and the connective tissue. A second variety is the *subcutaneous*, in which the connective tissue lying immediately beneath the skin is attacked. The third variety is the rare and insidious inflammation of the *post-mammary* or *subglandular* connective tissue between the gland and the chest-wall. This division of mastitis should not obscure the fact that clinically two or all three varieties may be combined, especially in cases which do not receive prompt treatment in the beginning, since either variety may end in a combination of all three. Mastitis commonly begins as the parenchymatous variety and approaches the skin-surface of the gland.

Etiology and Pathology.—The etiology of puerperal inflammations of the breast has actively been discussed in recent years, and, although the investigations of bacteriologists have wrought a change in our notions of the pathology of mastitis, the subject is not wholly free from uncertainty. Formerly it was believed that engorgement of the gland with stasis of the milk was invariably

the cause of all mammary inflammation; but this idea has disappeared largely, since most pathologists consider inflammation, wherever found, of microbic origin. Recent experiments have shown that stasis of the milk will not produce mastitis except when the milk contains bacteria. Ligation or stoppage of the milk-ducts by collodion (Kehrer) failed to produce inflammation of the breast in animals. The extreme rarity of mastitis in supernumerary breasts, and the fact that the frequency of the disease has been lessened so greatly since antisepsis has been extended to the care of the breasts, have also been advanced as arguments in favor of the unimportance of stagnation of the milk. There is, however, a clinical side to this question, which forces the belief that milk-stasis continues at least a predisposing factor in mastitis, especially in the very important parenchymatous variety. Stasis certainly is a frequent precursor of mastitis, whether the accumulation of milk in the gland results from hypersecretion, from failure to nurse at proper intervals, or from insufficient emptying of the gland when there is anatomical defect in the shape of the nipples or narrowing of their milk-ducts,—all of which conditions are known to bear an intimate relation to breast-inflammation. Honigman⁸⁶ disproved



FIG. 433.—Mammary gland: 1, lacteal ducts; 2, glandular acinus (Playfair).

the statement that human milk has bactericidal properties as regards the micro-organisms commonly found in mastitis; further, it is believed that a pent-up milk-secretion not only lessens the resistance of the breast-tissues against microbe activity, but that it also offers a very favorable medium for the rapid multiplication of bacteria. The experiments of Cohn and Neumann, before referred to,⁸⁷ demonstrate the fact that the micro-organisms ordinarily found in the milk are more numerous the longer the time since the removal of the milk. Although we must admit that stasis of the milk predisposes to mastitis, the evidence is overwhelming that the important element in etiology is infection.

Since the investigations in 1884 of Bumm,⁸⁸ bacteriological studies of mastitis and mammary abscess have proved that these diseases are the result of the irritant action of micro-organisms, and that the infection is usually due to *staphylococci*, *eti.* *aureus* or *albus*; sometimes *streptococci* are found; and Monnier⁸⁹ has shown that in some cases *staphylococci* are associated with other micro-organisms, such as *micrococcus tetragens*, *streptococcus*, or *micrococcus subflavus*. Thus it will be seen that the disease, like infection of the parturient tract, may originate from several different pathogenic organisms. The nipples, especially when eroded or fissured, are commonly the point of entrance of the infecting

agent, and the sources of infection are either the child's mouth, which is known to be the habitat of several micro-organisms some of which are pathogenic, or the patient's or nurse's fingers, or unclean appliances used about the nipple and breast, such as soiled cloths or an unclean nipple-shield or breast-pump. The exact manner of entrance into the breast of the infecting agent in all cases is not definitely settled, and the question is one about which there has been, and is, considerable controversy. It seems certain that the poison may, under varying circumstances, enter the gland either from the cutaneous surface through the milk-ducts, which path many pathologists believe to be most frequent, or through the lymphatics; or, circulating in the blood, the infecting poison may be excreted by the milk. The frequency of involvement of the lower segment of the gland, and the fact that in the early stage of mammary abscess pus and milk are so often coincidentally expressed through the nipple by massage, are thought to be evidences of the more frequent early involvement of the milk-ducts (Delbert). When cracks or fissures of the nipple are present, Pingat believes the poison is likely to enter the lymph-channels; and when the epithelium of the nipples is intact, the microbes may follow the milk-ducts to the acini, there multiply, and find their way into the cellular tissue. Orth thinks it probable that *streptococci* enter the lymph-channels and that *staphylococci* enter the milk-ducts. Williams remarks:⁹⁰ "As to the respective parts played by the lymphatics and ducts it is not easy to decide. It seems certain, however, that each has its rôle. In superficial inflammations of the breast, especially those of erysipelatous origin, most pathologists are agreed that the lymphatics are chiefly concerned in the spread of the disease. In other cases it seems probable that infection takes place chiefly by the ducts." The relative importance of the ducts and the lymphatics as pathways for the entrance of infection at first thought would seem to be a problem more of scientific interest than of practical value, since it is enough for prophylaxis to know that infection almost always occurs through the nipple, usually when the integument is broken, but possibly when the latter is intact. It will, however, be pointed out later, when the treatment of mastitis is considered, that for one means of treatment—namely, massage—it is of importance to learn, if possible, through which channel the infection has occurred.

The rarest and perhaps the least important channel of infection of the breast is by micro-organisms circulating in the mother's blood-current. It has been shown by Escherich⁹¹ that micro-organisms in the blood-current are often eliminated by the secretions, notably in the milk as well as in the urine. It is possible also that secondary to puerperal phlebitic infection of the genitalia a metastatic abscess of the breast can occur. Beyond these two facts little is known of mastitis and mammary abscess originating from infection of the mother's blood.

The actual pathological changes resulting from infection in and about the parenchyma of the gland are such as would be expected from micro-organisms rapidly multiplying and finding their way into the adjacent tissues. According to Bumm,⁹² the milk is fermented, its sugar converted into lactic and butyric

acids, and coagula of casein are formed containing innumerable bacteria. The epithelium lining the gland becomes swollen, desquamates, and disappears. At the same time leucocytes and micro-organisms infiltrate the periglandular tissues. Small foci of suppuration soon become numerous, coalesce, and form larger purulent collections. The cavities thus formed are traversed by shreds of partially destroyed tissues, and are surrounded by a protecting wall of leucocytes to prevent the further progress of microbe invasion and suppuration.

Symptoms.—All varieties of mastitis are accompanied by the signs of inflammation. The patient complains of chilly sensations or has a distinct rigor, followed by elevation of the temperature and by pain and tenderness in the affected breast. Each variety, however, has a train of symptoms more or less distinct. It will therefore be of clinical value to describe first the parenchymatous variety, which is the most frequent. Subcutaneous and subglandular mastitis are so commonly followed by suppuration that their description seems more appropriate in the section upon *Mammary Abscess*.

When the inflammation begins in the glandular structures of the breast there will be found one or more hard, localized, tender nodules due to stasis of the milk in these portions of the gland. The overlying skin is either not reddened or there may be only a faint tinge of redness. The pain produced by handling the breast is not severe. The temperature promptly rises to a great height—often to 104° F. or higher. The infection which has taken place through the lactiferous ducts is at this time producing those changes in the milk and the epithelium of the acini that have been described, and when prompt abortive treatment is not employed the more extensive inflammatory changes extending into the connective tissue are likely to occur.

Should the connective tissue surrounding the acini of the gland first become inflamed, an enlarged nodule is at this time not so apparent. The patient complains of an ill-defined painful spot, the temperature rises more gradually, and chilly sensations are complained of oftener than a rigor. The nipple has either recently been sore or will be found eroded or fissured, or upon close inspection a crack or an abrasion is observed at some portion of the areola. There is early redness of the skin that is soon followed by edema. It will frequently be noted that the location of the inflammation corresponds with the situation of the fissure of the nipple. Notwithstanding early treatment, this variety is more likely to resist resolution, the inflammation slowly progressing to abscess-formation, a termination especially liable to follow when the nipple is angrily inflamed and resists treatment.

The clinical signs above described are often clearly distinguishable. There are cases, however, in which both the acini and the surrounding connective tissue are apparently almost coincidentally affected, and the differentiating symptoms are correspondingly obscure. When there is doubt as to the exact variety of inflammation, it is a safe clinical rule to institute the treatment to be described for infection of the gland-acini.

Treatment: Prophylaxis.—The prophylactic treatment of mastitis should begin in the last months of pregnancy. Proper attention to the nipples, as

previously described, to get them in the best possible condition for suckling, will do much to prevent inflammation of the breasts. From the first application of the child to the breast three important means of prophylaxis are always to be borne in mind, and are to be impressed upon the mother or the nurse; they are: (1) The strictest cleanliness of the breasts and nipples throughout the entire period of lactation; (2) limitation of injury to the nipples by prompt measures to maintain their epithelium intact; (3) prevention of stasis of the milk secreted.

Curative Treatment.—When, notwithstanding all these precautions, inflammation of the gland actually exists, the indications are to put the gland absolutely at rest, to relieve it from tension and from the accumulated products of inflammation, to prevent further engorgement with milk and, finally, to lessen its blood-supply.

The first and always essential step in treatment, especially when the nipple is sore, is the immediate removal of the infant from the breast, to secure rest from pain and from functional activity of the gland, to promote healing of the nipple when eroded by avoiding traumatism and fresh infection, and, further, to avoid the danger to the child, slight though it may sometimes be, of absorbing milk changed in quality by the products of inflammation or even containing pus. This being effected, much has been done to prevent abscess-formation; the only advantage of suckling—removal of the milk—can be accomplished more safely and less violently by other means. The next step in the treatment will be to decide whether or not the inflammation is situated in the gland-acini, and whether the inflammation has so far advanced that efforts to prevent suppuration will likely fail. If these two problems could readily be solved, the selection of treatment to be followed in individual cases would not be difficult.

As has been stated above, the manner of onset, the condition of the nipple, the temperature, the character of the pain, the appearance and feel of the breast, and the relative frequency of parenchymatous and interstitial inflammation will often help a decision. When there is doubt, it is best to consider the case, at least temporarily, as one of parenchymatous inflammation. It is perhaps more difficult to determine whether or not the inflammation has advanced beyond the usefulness of abortive measures—in other words, whether or not pus-formation has occurred. When early improvement does not follow prompt and vigorous treatment, but, on the contrary, the case gets steadily worse and presents some of the signs to be described as evidences of abscess-formation, curative treatment short of surgical measures is not to be employed.

Having decided that the inflammation is largely parenchymatous, accompanied and aggravated by inspissation of milk, evacuation of the milk is to be obtained by skilfully applied massage, assisted by the proper use of the breast-pump, bearing in mind the fact that as the breast-pump only withdraws the milk from the large ducts near the nipple, too vigorous application of the pump should not be employed. Short of producing pain, the breast-pump is a valuable adjunct to massage, and the two, skilfully combined, will often more

readily empty the breast than will massage alone. Evacuation of the milk and relief of the tension in the breasts having been accomplished, further accumulation should be prevented by firm compression of the breasts. The lessening of blood-supply to the gland and the prevention of hypersecretion are also indicated, and are obtained by the derivative action of saline cathartics, which, to accomplish most good, should be given freely in the earliest stage. After this time their value in large doses progressively diminishes in cases seriously threatened, since an advantage is lost if the flow of milk is thereby almost wholly stopped, for the outflow of milk at the same time relieves the gland of the products of microbe activity.

After the employment of massage and compression of the breast the application of an ice-bag⁹³ to the binder over the painful lobe of the gland will further lessen the blood-supply and relieve the pain, and will have the well-known beneficial effect of cold upon the inflamed area, whether or not this effect is gained, as has been asserted, through its inhibitory power over the activities of micro-organisms. The ice-bag may be kept in place continuously for from twelve to twenty-four hours, the time being determined by the disappearance of pain and a fall in temperature. Thereafter it may be used intermittently during from three to six hours, until all tenderness of the breast disappears and the normal milk-flow is re-established.

In addition to employing the ice-bag, or when, as rarely happens, it is disagreeable to and not well borne by the patient, the application under the binder of compresses wet with lead-water and laudanum and covered with waxed paper is a most valuable means of allaying inflammation and relieving pain.

When the inflammation of the breast is thought to have had its origin in the connective tissues about the acini of the gland, the plan of treatment to be followed is somewhat different from the preceding treatment. In the first place, moderate support of the breasts, best obtained by the Murphy binder, should be employed, and not the firm compression of the breasts so useful in parenchymatous inflammation. Again, massage of the breasts can only be productive of harm in the interstitial inflammation, since the relief of milk-stasis is not so urgent and the tissues are further damaged by the manipulation. It is the failure to recognize this class of cases, in which expression is contraindicated, that has helped to make some authors condemn massage of the breasts. When the operator is in doubt as to the variety of inflammation present, or when the case presents evidence of both varieties of mastitis, as sometimes happens, and, it is to be confessed, makes a differential diagnosis difficult, it is best to resort to massage tentatively, giving it up and deciding that interstitial mastitis is present when by its use pain is not diminished and the temperature fails to fall. Abandoning firm compression and all efforts at expression, attempts may be made to combat the inflammation by the use of saline cathartics and by applying under the binder lead-water and laudanum or, which is of doubtful utility, belladonna, either the extract or the plaster. Should belladonna be used, its physiological action upon the pupils, the skin, and the throat must always be looked for, and the drug must be discontinued before a poisonous amount is

absorbed. The erosion or fissure of the nipple should promptly be treated, and be cured as speedily as possible. Notwithstanding active treatment, suppurative of the breast is very likely to be the outcome of interstitial mastitis.

MAMMARY ABSCESES.—Following the classification of mastitis, abscesses in the mammary gland may be located superficially under the skin or deeply under the gland; or most frequently the abscess follows mastitis, involving primarily, as has been pointed out, either the secreting structures of the gland or the connective tissue adjacent to the acini, and gradually approaches the skin. Two or even all three varieties may be associated. The parenchymatous variety, approaching and finally involving areas of the subcutaneous connective tissue, where pointing occurs, is most frequently seen. Deep-seated abscesses not vigorously treated by early and thorough opening may burrow in all directions and destroy the gland, or several portions of the breast may successively be attacked when incision and drainage have not been efficient.

Parenchymatous Abscess.—When the inflammation, aggravated by inspissation of the milk, originates in and is limited to the acini of the gland, active and persistent treatment by massage and compression will usually be followed by resolution; or sometimes the pain, induration, and fever will disappear, and after three or four days caseous milk and a small amount of pus will be expressed with the milk. The appearance of the latter is evidence that the inflammation has not wholly been aborted. If, on the contrary, the signs of inflammation do not disappear notwithstanding active treatment, it may be concluded that the interstitial tissues of the breast are either primarily or secondarily involved, and that we have to deal with the most frequent type of mammary abscess and one of the most painful and distressing complications of the puerperium. At the earliest possible moment the formation of pus should be discovered.

Symptoms.—There are, unfortunately, no absolute signs of suppuration short of fluctuation, yet in deep-seated or in slowly progressing cases it is dangerous to delay treatment until fluctuation is apparent. Left to itself, the pus will require about two weeks, or longer when deeply seated, to reach the surface. Frequently the abscesses are multiple and form in succession, and when neglected may recur for months. Velpeau observed 46 abscesses in one breast within a period of two or three months. The signs suggestive of abscess-formation are recurrence of a chill or a chilly sensation; greater rapidity of pulse; persistently high temperature; increasing dull pain in the breast; pain upon moving the arm, sometimes with enlargement and tenderness of the axillary glands; diminution in the flow of milk; bluish-red discoloration, with boggi-ness, adherence, and marked edema of the skin. Of these signs, rapid pulse, bluish discoloration and edema of the skin, and marked diminution in the flow of the milk are most important, and are enough to warrant an exploratory incision. It should be remembered that some fortunately rare cases of mammary abscess develop subacutely, without the ordinary signs of suppuration, or even of inflammation. The use of an aspirator-needle has been recommended for the detection of pus, although it is often of doubtful utility. Since,

to be effective, the needle always requires the preliminary use of an anesthetic, and since it may not find pus-collections which can be found by the finger through an incision, the aspirator-needle should be discarded for the more intelligent and less uncertain exploration with the finger.

Treatment.—The patient should always be anesthetized to open and treat a mammary abscess properly, except when the abscess is superficial or is about to point, in which cases a chlorid-of-ethyl spray or freezing with an ice-and-salt mixture will usually be sufficient. After rendering the skin thoroughly aseptic the breast is grasped, and by careful palpation the collection of pus should, if possible, be localized, and at its most dependent portion there is made, in a direction radiating from the nipple to avoid the milk-ducts, an incision sufficiently large to admit the finger and deep enough to incise only the skin and the subcutaneous tissues (about $\frac{1}{2}$ to $\frac{3}{4}$ of an inch). Through this opening a grooved director is gently passed in all directions until the abscess-cavity is found, when a dressing-forceps is introduced, by which the tissues are sufficiently dilated to admit the index finger into the abscess-cavity. With the finger all communicating and adjacent cavities are searched for and are freely opened and all friable tissue is broken down. The dressing-forceps or a probe is introduced, is pushed through the cavity to the skin-surface, and is cut down upon to make additional openings in order to secure free drainage. Several such openings should be made in the skin at the different portions of the gland where pus or induration has been detected by the finger.

After thoroughly dilating all entrances to the pus-cavities, thorough irrigation is made with an antiseptic solution. Peroxid of hydrogen, full strength, followed by a 2 per cent. solution of creolin, will be found efficacious. Weak solutions of carbolic acid or of bichlorid of mercury may be used. The subsequent treatment may be one of the following: The cavities and all openings may be packed firmly with sterilized gauze moistened by an antiseptic solution (1 per cent. carbolic or 2 per cent. creolin), followed by an antiseptic dressing under a firm bandage. After from twenty-four to thirty-six hours the gauze packing is gently removed, the cavities are irrigated with the peroxid of hydrogen diluted with three volumes of boiled water, followed by creolin (1 per cent. solution); strips of gauze are lightly placed in the drainage-tracts, and a compression binder is comfortably applied. The next day, if the discharge has almost disappeared, an antiseptic dressing is applied, and firm compression is secured by carefully-adjusted compresses placed under the bandage. A large aseptic bath-sponge,⁹ slightly hollowed to fit the breast and wrung out in a bichlorid or creolin solution, will provide firm and equable pressure under a very tight roller bandage; or the Y-binder may be employed, supplemented by a strip of muslin drawn tightly across both breasts to compress the summits of the breasts. Care should be taken to lift the breasts slightly toward the clavicles when the binder is applied. The antiseptic solution is poured under the edge of the binder often enough to keep the sponge moist. The sponge dressing is removed each day thereafter and the breast externally is gently washed. On the eighth or the tenth day the cavities and the tracts leading to them will usually

be closed, when the sponge compression may be discontinued. If the openings have not united, their edges may be brought together with adhesive strips or with collodion.

If drainage is desired by means of drainage-tubes, perforated rubber tubes at least one-fourth of an inch in diameter should be drawn through the openings after irrigation, and a firm binder should be applied over an antiseptic dressing. The next day the dressings should be renewed after irrigating the cavities, and the dressing may now be left undisturbed for four days; then the tubes should be shortened one-half their length, the cavities be irrigated, and the dressing be reapplied. So long as the pus is thick and tenacious the tubes will afford better drainage than strips of gauze, but if the progress of the case will permit, gauze should be substituted, otherwise the tubes should gradually be shortened, and they may be removed entirely by the end of at least ten days or two weeks. The disadvantage of the drainage-tubes is the tendency on the part of the physician to allow them to remain in the breast too long, and thus to cause fistulæ. The amount and character of the discharge and the disappearance of the cavities in the breast will indicate how soon the tubes may safely be removed.

The child, of course, must not be nursed from the diseased breast, but may be applied to the sound breast in order to keep up the milk secretion, provided the mother's general health does not indicate the desirability of weaning.

Convalescence is promoted by the administration internally of tonics, particularly quinin, strychnia, and iron.

Subcutaneous Abscess.—Subcutaneous inflammation of the breast is usually followed by the formation of an abscess, and it always results from infection through the superficial lymphatics, the septic material finding entrance into the lymphatics through erosions of the nipple or through a breach in the continuity of the areola or the adjacent skin. Usually the inflamed area is circumscribed; the overlying skin rapidly becomes very red, the temperature is elevated, and within a few days fluctuation is discovered, announcing the prompt occurrence of suppuration. The prevention of this form of inflammation is obtained by cleanliness of the breasts and nipples. In the beginning of the inflammation the administration of a saline cathartic and the application of compresses saturated with lead-water and laudanum, with or without an ice-bag, and held in place by a mammary binder without compression, will afford relief. At the first appearance of suppuration an incision should be made, either wholly within or outside the pigmented areola, to avoid an unsightly scar; the abscess-cavity should be irrigated with hydrogen peroxid, full strength or one-half diluted, followed by a creolin or a bichlorid solution, and after introducing a gauze drain a firm binder should be applied.

A diffuse inflammation of the subcutaneous connective tissue sometimes occurs, which condition is much more serious, but fortunately, is now very rare. It is usually, but not always, preceded by erysipelatous inflammation of the overlying skin, and is accompanied by chills, high fever, and severe burning pain. The axillary glands are often tender and swollen. The subcutane-

ous connective tissue quickly suppurates, and when not promptly treated by incision, drainage, and thorough antisepsis, extensive sloughing occurs, which may be followed by general pyemia and death. In the earliest stage the application of compresses wet with creolin solution (10 per cent.) or with lead-water and laudanum will be useful, but these compresses must not interfere with early recognition and evacuation of subcutaneous collections of pus.

Submammary Abscess.—In rare instances empyema or suppuration resulting from disease of the ribs may perforate the tissue under the mammary gland and produce an abscess situated beneath the mammary gland; but in the puerperium submammary abscesses practically always result from burrowing toward the chest-wall of a parenchymatous abscess. Several pockets of pus may thus be formed beneath the gland and at its periphery; the pus-cavities communicate after a few days, and the breast is lifted from the chest, the gland feeling as if it rested upon a fluid base, its overlying skin becoming tense, but usually not red. This variety of mammary abscess, the rarest, is of very great importance, because if overlooked most serious consequences may follow before spontaneous evacuation of the pus occurs. The inflammation of the connective tissue, which almost never undergoes resolution, may spread to the abdomen, to the other breast, and to the axilla, and pus may burrow in all directions, sometimes even attacking the ribs and perforating into the pleural cavity. The *symptoms* are not characteristic, since the deep-seated pain, the high fever, the edema of the overlying and adjacent skin, the restricted motion of the arm on account of the pain, and the involvement of the lymphatics in the axilla may be present in parenchymatous abscess, although these symptoms are usually less marked in the latter variety. The absence of marked redness of the skin and the peculiar sensation imparted to the gland by the underlying fluid collection are the most characteristic signs.

Treatment.—When this variety of abscess is suspected, the location of the pus-collections may be searched for with a sterilized aspirator-needle. After thoroughly disinfecting the skin, the patient ordinarily being etherized, the breast should be pushed toward the clavicle and the needle held parallel with the chest-wall, and, entering the skin on a level with the lower margin of the pectoral muscle in the infra-axillary region, should be thrust deeply beneath the gland. When the pus is located there is passed into the cavity a grooved director, which will serve to guide a pair of scissors or dressing-forceps, the blades of which, after being introduced, are separated and forcibly withdrawn. The cavity is then explored with the finger and adjacent pockets of pus are opened, especial care being taken to find and enlarge the opening or openings between the submammary and parenchymatous abscesses. Irrigation, drainage, and antiseptic dressings should then be employed as in other varieties of mammary abscess.

Abscesses in the Areola.—The glands of Montgomery and the connective tissue beneath the areola sometimes become infected, and the result is the formation of small and usually superficial abscesses. The abscesses are most frequently observed when the nipple is inverted or stunted, thus compelling the infant to

take into its mouth a portion of the areola in order to get a better grasp of the nipple. The skin at first reddens; the glands become hard and more prominent, and, pointing at yellow spots in their centres, finally perforate the skin at one or more places, leaving excavated ulcers surrounded by an indurated wall of lymph. These nodules may remain for several weeks, or, receiving fresh infection, they may break down, the ulceration being followed by an ugly scar.

Treatment.—Care of the nipples will usually prevent infection of the glands. Each gland when inflamed should be incised and touched with a strong bichlorid solution, after which the edges of the incision are approximated, covered with a narrow strip of gauze, and held together by a collodion dressing. Nursing need not be discontinued.

PROGNOSIS AND SEQUELÆ OF MAMMARY INFLAMMATION.—Mammary abscess is rarely directly dangerous to life. Fatal termination has been recorded from hemorrhage due to erosion of blood-vessels (Jacobs) and from septicemia (Gross). General sepsis, short of a fatal termination, may occur, seriously impairing the patient's health. In an interesting case of the writer's infection of the breast occurred when the patient washed her nipples with the same cloth and water used for cleansing the child's buttocks after a bowel evacuation; systemic infection followed, during the course of which there developed a serious albuminuria persisting for several months. When treatment by early removal of the pus and thorough antisepsis is neglected, a large portion of the gland, sometimes the entire gland, is destroyed. Even when the suppuration has not been very extensive, the firm cicatrices left behind frequently interfere with proper emptying of the breast in subsequent lactations, and thus predispose to the recurrence of mastitis. Milk-nodes and fistulous tracts may also remain, occasioning distress and inconvenience.

Milk-nodes.—Sometimes the exudate about the abscess-cavity is not wholly absorbed, and connective tissue thus formed may constrict one or more lacteal canals, giving rise to indurated nodular masses which contain the remains of inspissated milk and which may remain for an indefinite period. Effort should be made to promote the absorption of these masses by rubbing them with resolvent ointments, such as the ointment of mercury or of potassium iodid, and by the use of the galvanic current.

Cold or Chronic Abscess.—Very rarely the symptoms of acute inflammation of the breast subside, and after a long period severe inflammatory symptoms may occur. The purulent collection is often found under the gland, and it requires thorough evacuation, antisepsis, and compression.

Fistulæ of the Breasts.—A sinuous tract leading to the abscess-cavity may refuse to close and may discharge indefinitely a small amount of pus. A more important variety of fistula is that due to injury of a lactiferous duct, either wounded by the knife when the breast has not been lanced carefully or when perforated by extension of an abscess. Such a fistula may for months or for years discharge either milk alone or a mixture of milk and pus, which discharge may be a serious drain upon the woman's health. As a rule, little can be accomplished in the treatment of these fistulæ until the lacteal secretion has been

arrested, following which they often heal spontaneously. They will sometimes close under persistent compression and attempts to obtain granulation by injecting, twice weekly, irritative fluids, such as tincture of iodine, a 2 per cent. solution of nitrate of silver, or chlorid of zinc (gr. xx-xl to f $\bar{3}$ j). Thorough curettement and gradually shortened drainage-tubes have also been successful. These methods of treatment, especially in intractable cases, have been discarded in recent years for excision of the fistulous tracts and immediate closure by deep and superficial sutures.

Galactocoele.—Sometimes one of the lactiferous ducts happens to be occluded permanently, and in consequence the milk accumulates and forms a cystic tumor which is usually of no pathological or clinical importance unless it should, as rarely happens, attain an extreme size, when it may be tapped and drained and cicatrization of the cyst-wall be promoted.

7. ARREST OF LACTATION.

There are in practice three periods during which it may be desired to arrest the secretion of milk: (a) immediately after delivery when the child has not survived birth, or when the constitutional condition of the mother is such as to preclude the possibility of successful lactation; (b) at any stage of lactation when weaning has been determined upon in the interest of either the infant or the mother; (c) at the end of the lactation period. It should be remembered that the danger of drying up the breasts varies with these periods, being greatest when the functional activity of the glands is at its height, and least dangerous at the end of lactation, when nature is about prepared for the cessation of this function.

Whenever the prevention of activity of the mammary glands is desired in the first period, diminution of the flow of milk can be accomplished by using before the first appearance of breast-engorgement a firm compression binder, a roller bandage, or for very threatening cases a dressing of contractile collodion may be employed, and also by forestalling the milk-flow by the early administration of salines to the extent of free purgation when the patient's strength will permit. In addition to compression and purgation, it will usually be necessary to resort once or twice daily to gentle massage of the breasts or to the use of the breast-pump to prevent dangerous engorgement—a danger usually passed by the fourth or fifth day, certainly by the end of the week. The employment of potassium iodid to arrest the secretion of milk is of doubtful utility: used in safe doses, this drug is without effect; in a large dose (30 grains) it sometimes is apparently effective, but is often followed by serious symptoms of poisoning.

To arrest the milk-flow in the second period, after lactation is well established, the compression bandage and free purgation will be sufficient when the milk flows readily under the pressure and there is no disposition of the breasts to become engorged and caked. Under these conditions it is an advantage to omit massage or the use of the pump, since this omission renders the treatment less painful to the patient and of shorter duration, for after massage or suction

of the milk by the pump the breasts rapidly refill. When, however, the breast fails to drain under the bandage and nodular masses are felt, it is imperative to relieve the tension by massage, on account of the danger of mastitis.

The management in the third period is usually a simple matter. As the child is gradually taken from the breast the slight tension of the breasts observed when a nursing has been omitted should be relieved by gently stroking the breast or by the use of the breast-pump. Within a few days the flow of milk usually disappears. Should a small amount of secretion persist, it may be necessary to employ compression; atropia administered internally will sometimes assist in further drying up the secretion (see page 773).

8. ANOMALIES IN THE MILK-SECRETION.

In this section will be considered the following abnormalities associated with the mammary function: (a) secretion of milk abnormal in quality or in quantity, and the effect of either of these changes upon the health of the mother or of the child; (b) conditions interfering with the performance of the mammary function; (c) weaning; and (d) the ill effects of prolonged lactation.

ABNORMALITIES IN QUALITY.—The quality of the milk of the nursing mother is influenced by many conditions; and while variations may be observed in the proportion of any or of all of its constituent elements, or even in the presence of foreign elements, the proportion of fat and albuminoids under ordinary circumstances shows the greatest and most important variations. The proportion of sugar is remarkably constant under all circumstances, and there is very little variation in the percentage of salts. A very common cause of impairment in the quality of the milk-secretion is a failure to give proper attention to the time of putting the infant to the breast. Nursing at too frequent, prolonged, or irregular intervals materially alters the condition of the milk, and renders it either difficult of digestion or of poor nutritional value. A very common mistake made by inexperienced mothers is the frequent application of the child to the breast when it is restless, under the mistaken idea that the infant requires more food, when, as a matter of fact, an excess of food, with consequent indigestion, or thirst, is the real cause of the child's discomfort. When the breast is given to the child at shorter intervals than two or three hours, the milk rapidly becomes more concentrated, and therefore is digested with great difficulty. On the contrary, when a longer interval between nursings is permitted, the solids of the milk are so reduced as seriously to diminish its value for nutrition.

Perhaps the most important factor influencing the quality of the milk is the diet of the nursing mother. A diet largely vegetable will increase the proportion of sugar and diminish that of fat and caseinogen, while an excess of albuminous food will increase the fat and caseinogen and diminish the proportion of sugar. In each case the infant receives food ill adapted to its needs, and will either be poorly nourished or, when the fat and caseinogen are in excess, there will soon appear digestive disturbances with their associated dangers. The employment of alcoholic and malt liquors will also lead to an excess of

fat and caseinogen. There is a widespread belief, not only among the laity but also among the profession, that the nursing mother should add to her diet some preparation of malt to improve the quality of her milk. While it is true that in exceptional cases distinct benefit is thus to be obtained, the indiscriminate use of such preparations certainly does more harm than good. Zaleski⁹⁵ found that not only were fat and albumin increased in the milk of mothers taking malt, but that the milk sometimes actually contained alcohol and the micro-organisms peculiar to malt liquors. Klingeman⁹⁶ learned from his investigations that when the nursing mother took alcohol in moderate quantity there was no evidence of its presence in the milk. When the quantity ingested was increased, a small amount of alcohol passed into the milk, which amount he thought was usually insufficient to have an ill effect upon the suckling. The changes produced in the constituents of the milk, however, were quite noticeable, and Strumpf is quoted as authority for the statement that alcohol taken by the mother so changes the fatty and albuminoid contents as to diminish the nutritional value of the milk. The milk should be known to contain too little fat and caseinogen before recommending the use of malt; and when malt is taken, the first appearance of digestive disturbance in the infant calls for either a reduction in the amount ingested or for complete abstinence. As a matter of experience it is in the latter half of the lactation period that the mother's milk is more likely to be deficient in the constituents for whose increase a malt preparation is indicated, and the common practice of advising mothers to drink stout or other malt liquors shortly after labor is certainly reprehensible in a very large number of cases. Careful analyses of the milk may be made at intervals, to determine the proportion of fat and albumin, and these analyses will indicate the desirability of administering or withholding malt, and will often indicate other desirable changes in the diet.

The diet of the nursing woman should ordinarily not differ materially from that to which she has previously been accustomed. It should consist of plain mixed food with a moderate excess of fluids. Of the latter, milk taken between meals is useful; tea and coffee are best withheld or taken in moderation and largely diluted; cocoa is sometimes useful.

When the child does not thrive upon its mother's milk, or when it presents serious digestive derangements, a chemical analysis of the milk should be made. Having decided upon a chemical examination of the milk, it should be borne in mind that the relative proportion of the constituents of the milk varies with the time of its withdrawal from the breast. The first portion removed contains a smaller, while the last will show a larger, portion of solids, hence the specimen should be taken after the infant has about half-emptied the breast. Since each mammary gland may yield a different quality of milk,⁹⁷ and since the quality of the milk also varies at different intervals, several specimens from both glands should be subjected to analysis to obtain an absolutely accurate estimate of the quality of the milk.*

* If it is impossible to obtain an analysis by an expert chemist, the following method, sug-

Microscopical examination of the milk to count the number of milk-globules, as proposed by Bouchere and recommended by Kleinwächter, is no longer considered of practical value. This method of analysis cannot take the place of careful chemical analysis. The microscope, however, is sometimes useful—for example, to recognize the presence of colostrum-corpuseles and foreign matters, such as pus, blood, and epithelial cells.

The later and most reliable analyses of human milk show an average composition as follows:

Water	87-88.
Total solids	12-13.
Fat	3-4.
Albuminoids	1-2.
Sugar	7.
Ash	0.2.
Reaction	Faintly alkaline.
Specific gravity	1028-1034. ¹⁰⁰

If the proportion of fat is below the normal amount (3.15 per cent.—Temesváry),¹⁰¹ the diet should be modified by reducing slightly the fatty food and increasing the proteids. If, on the contrary, the milk is too rich in fat and albumin, less meat and more vegetables should be given, and at the same time the employment of additional muscular exercise with daily baths is important. A change in diet alone will not reduce the proportion of caseinogen, which is commonly in excess in the upper class of women, without reducing at the same time the other constituents; hence the resort to systematic muscular exercise is essential. Much can often be accomplished by these means to adjust a proper quality and quantity of milk for the child; but not infrequently, despite all efforts, the child's condition fails to improve, and it becomes necessary for its welfare to resort to artificial feeding.

Sudden fright or joy, great anxiety, and other emotions in the mother have a peculiar effect upon the quality of her milk. We have no intimate knowledge of the changes thus brought about, beyond the clinical fact that indigestion and colic are of frequent occurrence in infants nursed by emotional mothers, whose milk, it is asserted, is likely to contain more water, less fat, and more caseinogen than normal. The nursing mother should be made aware of this fact, and be cautioned to lead a life as free as possible from emotional excite-

gested by Nias,⁹⁹ and considered by him sufficiently accurate for clinical purposes, may be employed to estimate the amount of fat and albuminoids: Add enough liquor potassa to the sample of milk to render it distinctly alkaline; place in a test tube, boil, and set aside in a warm room for a few hours. The fat will rise to the surface, and the amount may be estimated by a graduated rule placed at the side of the tube. To determine the amount of albuminoids, remove the layer of fat with a pipette, add sufficient acetic acid to the remainder to render it acid, boil, and again set aside in a warm room. All the albuminoids will be precipitated, and may be estimated in the same manner as the fat. There may be used with advantage a test-tube graduated in hundredths, in which a sample of milk known to be normal has been tested by this examination, and thus offers a standard for comparison. With this modification the writer has found this method useful for approximate analysis. The method of Holt⁹⁹ may also be used for the estimation of the percentage of fat and for detecting wide variations in the percentage of proteids.

ment. In extreme cases of emotion the milk can be so changed as to become actually a fatal poison to the child.

The age of the mother and the period of lactation modify the quality of the milk. As the age advances the proportion of albuminoids gradually diminishes, and, beginning with the sixth month, as lactation advances the percentage of proteids becomes somewhat less (Kolesinsky).

An excessive quantity of fat, according to Monti,¹⁰⁹ will appear in the milk when the mother is affected by serious acute pathological processes, as mastitis or any other extensive febrile process. The same observer has sometimes noticed a gradual diminution in the proportion of fat in the presence of pathological processes of long duration. The qualitative changes in the milk produced by acute febrile diseases, by blood-changes in the mother, by the presence in the milk of micro-organisms, and by the reappearance of colostrum-corpuscles will be referred to in a subsequent section.

ABNORMALITIES IN QUANTITY.—Abnormalities in the quantity of the milk may vary from an entire absence of secretion to an enormously excessive supply, which may even continue after the child has been weaned.

The normal amount of milk secreted by the mammary glands is very difficult to determine, since there are wide individual variations within the limits of health. Temesváry,¹⁰⁸ in a long series of examinations after lactation had fully been established, found the average amount of milk from one breast to be 59 cubic centimeters (2 ounces), the variations being between 30 and 70 cubic centimeters (1 to 2½ ounces). Ordinarily the total quantity of milk secreted in twenty-four hours is 414 cubic centimeters (14 ounces) at the end of the seventh day; this amount steadily increases for a month, when the quantity has reached about 2 pints, after which time, to meet the demands of the growing infant, it has increased to 3 pints at the seventh month, and after the eighth month the quantity gradually decreases.

Agalactia.—Complete absence of the milk-secretion is of such very rare occurrence that its existence has frequently been doubted. Usually there is only a deficiency which may occur at the beginning and continue throughout the whole period of lactation; or more commonly the secretion, at first sufficient, gradually diminishes in amount or from some intercurrent affection suddenly disappears. The secretion of an abnormally small amount of milk may be due to an anomaly in the formation of the mammary glands, either congenital or acquired from faulty clothing compressing the glands; it is observed also in the very feeble, in women of advanced age, after premature births or stillbirths, and in women who carry an excessive amount of adipose tissue.

Diminution in amount of a secretion previously abundant is a most important and very frequent anomaly of the mammary function. It is often observed in women of the working-classes, who shortly after confinement are compelled to perform an excessive amount of work in the management of their household affairs, and commonly are deprived of nourishment suitable to the formation of a sufficient quantity of milk. When it is remembered that

milk-secretion is a physiological function depending, as do other functional activities of the organism, upon the condition of the woman's health, it will readily be seen that any condition unfavorable to the mother's general health will interrupt the activity of the mammary glands. Thus, diminution of the milk is observed when there are unfavorable hygienic surroundings and when vitality is lowered from frequently recurring pregnancies or from inter-current diseases, especially such as are accompanied by profuse discharges, as diarrhea or excessive menstruation. Temporary diminution or disappearance of the milk occurs when there is high fever and when inflammation of the breast is present.

Treatment.—Insufficient milk due to defective development of the mammary gland practically cannot be increased. In such cases the only recourse is artificial feeding. In very exceptional instances electricity and massage have contributed to awaken a torpid gland to increased activity, but when there exists extensive actual anatomical defects even these agents accomplish little or nothing. Mensinga, however, recorded¹⁰⁴ an interesting case in which persistent massage for a week succeeded in establishing a flow of milk when in six successive pregnancies there had been an absence of milk. In other cases much may be done to increase the quantity and improve the quality of the milk by critically studying the mother's general condition and by giving especial attention to her diet. Her hygienic surroundings should be improved. If there is depressed vitality or ill health from any cause, this must be removed. Benefit often follows a change of air and scene with freedom from care and overwork. The diet should be modified by the addition of milk, farinaceous food, and a proper quantity of malt, and particular attention must be given to the patient's stomach-digestion, to ensure the proper assimilation of her modified and increased diet. Bitter tonics, particularly *nux vomica* with pepsin and a mineral acid, will often be of value in promoting digestion. More can be accomplished by these means than by any of the so-called "galactagogues," all of which are of doubtful value.

Polygalactia.—A supply of milk greatly exceeding the need of the infant is of rare occurrence. Sometimes at the beginning of lactation the milk is formed in larger quantity than the child requires, but this excess soon disappears and supply and demand are finally equalized. At times, however, in vigorous, plethoric women the milk-secretion is so abundant and is accompanied by so much discomfort to the patient that means must be employed to diminish the flow. This diminution can be brought about by restricting the diet and the amount of fluids ingested, by the administration of salines, by employing compression of the breasts, and by advising longer intervals in putting the child to the breast.

Galactorrhea.—Very excessive secretion of milk of poor quality toward the end of a prolonged lactation, and the continuation of the secretion after the child has been weaned, are included under the term "galactorrhea." As a rule, both breasts are at fault. The quantity of milk secreted is usually sufficiently large seriously to impair the patient's health; in some cases the

quantity secreted may be enormous. The cause of galactorrhea is unknown. Relaxation or paralysis of the circular muscular fibres surrounding the milk-ducts has been considered a cause by some authors; by others the condition has been considered to be an effect of extreme physical exhaustion.

Symptoms.—The symptoms, aside from the almost constant flow of milk, are those to be expected when so constant a drain is made on the individual's strength. Nutrition is interfered with; extreme anemia and emaciation are present, and are soon followed by some of the nervous disturbances to be described as accompanying hyperlactation.

Treatment.—Pronounced galactorrhea is a very stubborn affection, often continuing for a very long time despite treatment. Vigorous compression of the breasts, free action of the bowels, and the administration of iodid of potassium are generally useful. Electricity is often disappointing. Ergot has given good results in some cases, and atropia is said to be satisfactory sometimes, particularly in those unable to stand free purgation. The treatment directed to the patient's general ill health—iron and other tonics and nutritious diet—has doubtless been a large factor in accomplishing the good results claimed for various special agents, as occurred in a case under the care of the writer, who, from the patient's general condition, was impressed with the belief that galactorrhea is perhaps only one expression of a neurosis.

Conditions Interfering with Suckling.—Ordinarily, the condition of the mother that interferes with the performance of the mammary function is one of simple loss of strength and flesh. There are, however, several more definite conditions that may be present at the outset of the lactation period, or that later may develop at any stage of this period. The more important of these complications will be considered briefly in the order of their relative importance.

Faulty Development of the Mammary Glands.—The anatomical structure of the mammary glands may in some individuals be very deficient in the development of the glandular element, connective tissue having replaced the gland-structures to such an extent as to preclude the possibility of the mother supplying sufficient milk for her child. This defect is apparently inherited in rare cases. It is observed in women of ill-developed physique, and may be acquired through undue compression of the mammary glands by faulty clothing, or where the mother in each recurring period of lactation refuses to nurse her child. Little can be done for this condition, and, as a rule, artificial feeding is necessary. Where atrophy of the glandular elements is only partial, electricity, by stimulating the secretory function of the epithelial cells, accomplishes at times some improvement, although it is a measure more often disappointing. The same may be said of massage of the breasts.

Diseases.—At any time throughout the period of lactation temporary cessation of breast-feeding may be necessary by reason of intercurrent disease of the mother. Thus a fissured nipple often requires the withholding of one breast for twenty-four or forty-eight hours, and a mammary abscess will interdict nursing from the diseased breast until complete convalescence is reached. Likewise, the child must be weaned temporarily in any acute disease danger-

ously depressing the mother's strength or exposing the child to infection, such as the exanthemata, erysipelas, diphtheria, typhoid fever, malaria, and grave puerperal sepsis. When convalescence has been established the milk will usually reappear, and the child should be returned to the breast.

The presence, from any cause, of persistently high fever in the mother is in itself an indication for removal of the child from the breast. Fortunately, Nature usually takes this matter in her own hands, for it is a clinical fact that the milk-secretion soon disappears when the temperature is high and when the milk has thereby become injurious to the child. Schling¹⁰⁵ confirmed the experiments of Fehling, who has shown that within certain limits milk from a fevered mother has no ill effect upon the child. When the temperature is very high and persists near 104° F., a corresponding fever-curve soon appears in the child—a phenomenon not to be wondered at in the light of investigations which find, as in mastitis, the same micro-organisms in the mother's milk and in the child's intestinal canal.

The experiments of many bacteriologists, notably those of Konigman¹⁰⁶ and of Cohn and Neumann,¹⁰⁷ disprove the notion, formerly so widespread, that a healthy mother's milk comes from the breast absolutely sterile. On the contrary, they have found that the milk of healthy nurses contains micro-organisms in the vast majority of cases. The micro-organism commonly found is the *staphylococcus pyogenes albus*; next in frequency, the *aureus*; and other microbes very seldom and in small number. The microbes find their way into the milk usually from without—probably from the skin into the ducts through their orifices on the nipple. Occasionally, however, the blood-current of the mother afflicted with septic disease is the medium of their entrance into the milk (Escherich, Longard, and Karlinski).¹⁰⁸ Ordinarily the milk containing the cocci commonly found in breast-milk produces no ill effect upon the infant. The investigations above referred to demonstrated that the child's intestines are capable of bactericidal action. The stools of children taking milk known to contain cocci were examined, and it was found that the cocci had been destroyed in the intestine. Cohn and Neumann further remark, however, that we must admit the possibility of infection in weak children, to which infection is to be attributed some of the cases occasionally recorded of abscess-formation in the new-born infant. When the milk happens to carry micro-organisms of more virulent character, as in some cases of mastitis, serious disease in the child may appear. Cases of gastro-intestinal disorders, of diphtheroid stomatitis, and of retropharyngeal and submaxillary abscesses are not uncommon, and even otitis media, dacryocystitis, and purulent ophthalmia have thus originated (Damourette).¹⁰⁹

The reappearance of the colostrum-corpuscles in the mother's milk, perhaps the most valuable result to be obtained by microscopical examination of the milk, is not only a phenomenon of medico-legal interest, but is also of practical value in determining the quality of the milk, since the presence of these corpuscles after the eighth or the tenth day indicates qualitative changes in the milk which disagrees with the child. We have no intimate knowledge of these

changes, nor do we know why the corpuscles reappear. During the first week of lactation these corpuscles are numerous, and their presence at this time is physiological. At various periods throughout lactation they reappear, when the milk is found deficient in nutritive value. They have been observed to reappear when the mother has been affected by some profound nervous impression, such as excessive grief, fright, fatigue, or sexual excitement. Inter-current diseases, particularly anemia, are often accompanied by their reappearance. Occasionally they are observed during a return of menstruation. It is also a curious fact that drugs administered to a nursing mother more readily pass into the milk during a colostrum period. The reappearance, therefore, of colostrum-corpuscles in large numbers after the second week of lactation is an indication to at least temporarily discontinue nursing.

The diseases which make permanent weaning necessary are not numerous. Phthisis, either incipient or developed, endangers the mother by rapid advance of the disease, and not only exposes the child to infection by the transfer of the tubercle bacillus in the milk, as in a case clearly demonstrated by Steigenberger,¹¹⁰ but also adds a risk of ill development on account of the impaired nutritive quality of the milk. A mother known to have syphilis may be allowed to suckle her infant, provided the child bears unmistakable evidences of the disease, and provided also her general condition is such as to furnish a supply of milk of suitable quality and quantity. The testimony of the changes in the ingredients of the milk of syphilitic women, apart from its capability of transmitting the disease, is contradictory, and is doubtless due to the varying condition of general health in those afflicted with syphilis. When, however, the infant has apparently escaped infection, the mother should not be permitted to risk infecting the child by her breast-milk. In this connection it is desirable to remind the student of Colles's well-known law that a mother may suckle her evidently syphilitic child without fear of being herself infected. A syphilitic child should never be given in charge of a wet-nurse without informing the nurse of her danger of infection—a danger and risk so great as to induce Fournier¹¹¹ to make the statement that the practice of wet-nursing syphilitic infants should be prohibited by law. It will often be necessary to discontinue nursing when the temperament of the mother is so highly emotional as repeatedly to produce serious qualitative changes in her milk. The existence of or predisposition to goitre contra-indicates suckling, since this disease is thereby aggravated; in some cases goitre has first appeared during the lactation period.

Anemia.—An impoverished condition of the blood after labor renders the puerpera incapable of supplying a proper quality of milk, and further depletes her vitality to such an extent that nursing must be omitted both for her own and for the child's best interests. It is therefore inadvisable to permit suckling to be continued when a profuse hemorrhage has occurred at the time of delivery, or when a condition of advanced anemia has developed during pregnancy, with or without albuminuria, in which case the frequent tardy involution of the blood will be even more delayed. It is, moreover, certainly rational to

believe that the blood of an albuminuric woman cannot supply the material for a perfectly healthy milk-secretion.

Return of Menstruation.—Among the laity the notion is very widespread that a return of the menstrual function makes it imperative to discontinue nursing. When the amount of blood lost is sufficient to produce anemia, it will always be desirable to wean the child. Ordinarily the flow is not excessive and may be very irregular, and the impairment of the milk is only temporary, as shown by the transient digestive disturbance in the child. Under such conditions it would certainly be unwise to resort to artificial feeding unless the child's condition clearly indicated that it was not thriving, which sometimes will be the case when the menses return regularly and profusely. Schlichter's¹¹² observations, during a period of five and a half months, of 52 children suckled by women in whom menstruation had appeared, found that only one child became dyspeptic, and that this child showed a normal gain in weight. Thirty-three milk-analyses were made, and they showed on an average less difference between the milk of a non-menstruating and a menstruating woman than between the specimens of milk taken from an individual at morning, noon, and evening. The advisability of discontinuing nursing when the menses return should always be decided in individual cases by a critical study of the health of both mother and child.

Pregnancy.—The experience is universal that a mother cannot continue to supply nutriment for both her unborn and her living child; and, leaving out of consideration the possibility of the occurrence of miscarriage through the intimate reflex association of the uterus and the mammary glands, lactation and pregnancy are incompatible, and are not to be sanctioned except when serious illness in the suckling makes a supply of breast-milk specially urgent for a short time.

Drugs.—It is recognized as a clinical as well as an experimental fact that various drugs are in part eliminated by the mammary gland, not only when the milk is in a poor condition, but also when the nursing mother is apparently perfectly healthy. Alcohol, quinin, salicylic acid, arsenic, lead, iodoform, potassium iodid, mercury, the poisonous alkaloids, narcotics, belladonna, and a few other drugs have been found in the milk of nursing women. Knowledge of this subject has largely been gathered from accidents occurring to the infant when the nursing mother has been treated for intercurrent diseases.

Burdell¹¹³ reported fatal illness in an infant whose mother had been cinchonized, and he advises withholding the breast until the milk containing the quinin is withdrawn.

Vinay¹¹⁴ observed a distinct odor of nicotin, though chemically it was not shown to be present, in the milk of mothers exposed to the vapors of nicotin in tobacco-factories, and he noted the appearance of serious illness in the child upon the mother's return to the factory, which illness disappeared when the milk was given up. Doses of the poisonous alkaloids physiological for the mother may at times pass through the milk in quantity sufficient to be poisonous to the child. This is especially true of atropia.

Fehling¹¹⁵ and Schling¹¹⁶ have experimentally studied the action upon the infant of various drugs ingested through the mother's milk, and they point out the fact that the time required for partial elimination by the mammary glands varies with different drugs.

The frequently observed laxative action upon the child of salines or of compound licorice powder administered to the mother is sometimes utilized for the benefit of the infant, but beyond this the writer is acquainted with no exact experimental or clinical studies of the medicinal treatment of infants through the breast-milk. According to Barnes, syphilis in the infant may thus be cured.

Weaning.—As the normal period of lactation is relative, often depending upon individual capacity for the production of milk and for enduring the strain of lactation, it is difficult to name a period throughout which the child should be fed exclusively from the breast. Ordinarily nine months is the limit, but in some individuals lactation may be extended throughout a year without detriment to mother or child. After twelve months the changes in the quality and quantity of the milk, the appearance of teeth in the child, indicating nature's preparation for other food, and the beginning ill effects upon the mother of prolonged lactation, make it imperative to remove the infant from the breast. There are, of course, a few conditions which will allow a continuation of lactation for a brief period beyond twelve months. It would, for example, be unwise to wean a child at the approach of midsummer, or when it had recently recovered from a serious illness, or when in the midst of a dental period. Whenever weaning is decided upon, it is best, as a rule, though not always necessary, to give artificial food gradually, substituting at first one or two bottle-feedings daily, and gradually increasing the number until finally, in the course of several weeks, the breast-milk is no longer used. At the end of the sixth month it is a good rule to investigate the quantity and quality of the mother's milk and the condition of the child, and to observe the effect of lactation upon the mother's health. If, as is quite common, this investigation indicates the desirability of weaning, this should be begun, and by the end of the ninth month the breast-milk may be omitted.

Hyperlactation.—Prolongation of the lactation period beyond the usual time for weaning—from the ninth to the twelfth month—is not at all uncommon among the poorer classes. The ill effects upon the mother and the child are numerous, and the consequences to both are frequently very grave. These effects are more frequently seen in women of weakly or strumous constitutions whose vitality has been depressed further by the strain of pregnancy and lactation. The *symptoms* of the condition, to which has been given the name *tubes lactea*, are unmistakable. The quantity and quality of the blood are impaired; the patient is pale, emaciated, and complains of aching pain in the back and loins, and in the breast when the child is suckled. There is loss of appetite, and muscular and nervous weakness with insomnia, headache, and vertigo. In many cases, further neglected, hysteria or more serious changes in the nervous system may be followed by insanity. Cramps and contractions of various

muscles, beginning with tingling, are frequently observed; even speechlessness, dysphagia, orthopnea, and attacks of syncope have been noted. Serious derangements of the eyes have also been observed as a result of the extreme reduction of the vital powers and the impoverished condition of the blood, varying from a mild conjunctivitis to ulceration of the cornea or retinitis with total loss of sight. In those predisposed to phthisis this disease frequently develops at this time. Hyperlactation, on account of the associated debility, sometimes is an etiological factor in the development or aggravation of skin affections, particularly psoriasis.

The treatment of hyperlactation is the prompt weaning of the child and the use of tonics, nutritious food, and a temporary change in the patient's surroundings. Usually rapid improvement follows.

III. DISEASES OF THE NON-SEXUAL ORGANS.

1. FEVER DUE TO CAUSES OTHER THAN PUERPERAL INFECTION.

While it is true that sometimes a rise of temperature in the puerperium occurs wholly independent of infection, it is also true that from a clinical standpoint the safest rule is to believe that fever occurring during the puerperal period always has an infectious origin until indubitably proven to be due to some other cause. There are, however, several conditions which not infrequently are observed to produce non-infectious fever in the puerperium. One of the most important causes of fever having a non-infectious origin in the puerpera is, for want of a better explanation, called "reflex irritation." When it is remembered that during the puerperal period the patient's nervous system has not fairly begun to recover from the nervous irritability which was so pronounced throughout pregnancy, it is easy to understand that causes which in health would have little if any effect upon the patient's nerve-equilibrium will, out of all proportion to their magnitude, produce marked effects upon the peculiarly nervous susceptibility of the puerpera. The sudden rise in temperature so commonly observed associated with congested and engorged mammary glands (Fig. 434) or with a sore nipple is certainly in large measure due to reflex irritation, although the element of infection in some cases is partly responsible for the fever, especially if the latter continues, in which event mastitis should be suspected.

Exposure to cold, with consequent internal congestion, especially of the breasts and of the abdomen, is also a cause of transient fever in puerperal patients who have been careless about proper protection with clothing or who indiscreetly expose themselves soon after labor. The chart (Fig. 435) illustrates such effect upon a woman who left her bed eight days after her delivery and walked through an unprotected corridor to the closet. Soon after her return she was taken with a chill and her temperature rose as indicated in the chart. After the administration of a hot punch and the protection of an extra blanket the fever disappeared.

Emotion is recognized as a cause of fever independent of the puerperium.

That profound emotion markedly influences the temperature in the early puerperium is well known, but the exact mechanism of the production of fever by this cause is unknown. The appended charts are of two cases recently observed by the writer. The rapid rise of temperature observed in one (Fig. 436, A) followed the thoughtless announcement to the patient that her husband

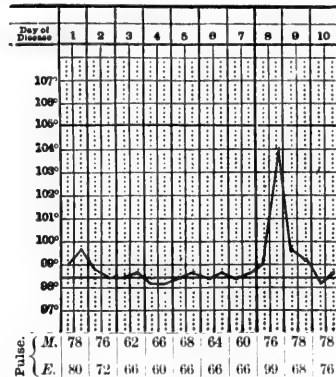


FIG. 434.—Fever following exposure to cold.

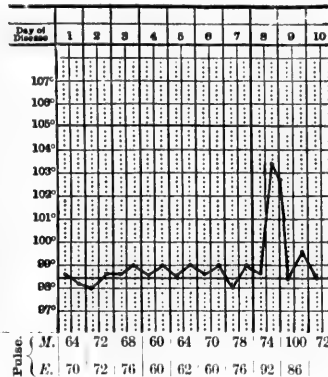


FIG. 435.—Elevation of temperature due to engorgement of the mammary glands.

had been killed in a railroad accident. The secondary rise of temperature was due to the patient's anxiety about her inability to provide for herself and child, which anxiety was relieved by promised assistance. Figure 436, B is the chart of a patient who occupied a bed adjacent to a companion who manifested signs of mild puerperal insanity. The insane patient declared that during the

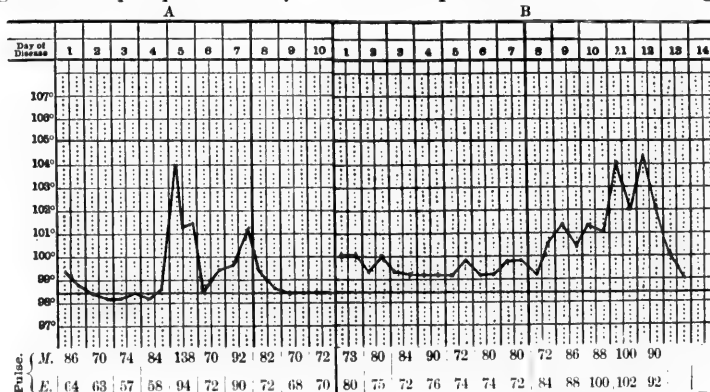


FIG. 436.—Fever due to emotion.

night her infant had been exchanged for the sane patient's child, and insisted that the latter patient should surrender her child, which the insane woman claimed as hers. The anxiety and trepidation of the patient whose chart is here exhibited was so great, and the rise of temperature was so coincident and

pronounced, that the relation of cause and effect could not be mistaken. Upon removing the insane patient to another room the alarm of the anxious mother disappeared and her temperature fell at once to the normal.

Acute constipation in the puerperium is a frequent cause of fever, which is doubtless due to the irritation of retained animal alkaloids. This phenomenon is another example of the susceptibility of the nervous system to various forms of irritation that at times other than the puerperium produce little or no effect.

When a patient, before or during pregnancy, is the subject of a disease accompanied by fever, the elevation of temperature will usually be increased during the puerperium, since an exacerbation of the disease is likely to occur. The fever-curves of phthisis, of pneumonia, of typhoid fever, and of other serious diseases are thus modified.

Very high fever is often observed when serious disturbances of the brain complicate the puerperium, such as cerebral hemorrhage or embolism or eclampsia. It is possible for a puerperal patient to be stricken with thermic fever, and the essential fever of syphilis is sometimes observed in the puerperium.

2. INTERCURRENT DISEASES.

The puerperal patient may, of course, be attacked by any acute disease. There are, however, a few diseases which it is desirable to mention briefly, since their relation to the puerperal period is of more than ordinary importance.

Exanthemata.—In recent years the important relation of the exanthemata to puerperal infection has been better understood, and there is now little doubt that the germs of the virulent infectious diseases may effect an entrance into the puerperal patient either through their ordinary and peculiar modes of entrance, or through wounds of the genitalia, which latter channel is relatively far more frequent, more dangerous, and therefore more important. When any of the exanthematous diseases occur as complications of the puerperium without symptoms or signs of infection of the genital organs—a very infrequent occurrence—the *prognosis* is more grave and the *treatment* is the same as under other circumstances, with rigid antiseptic precautions added to prevent invasion through the parturient canal.

Scarlet Fever.—When scarlet fever is contracted by the puerperal patient the poison having been introduced through wounds in the genital canal, the clinical course of the disease is greatly modified. The incubation period is shortened to twenty-four or forty-eight hours. The *diagnosis* is usually obscured by the fact that other forms of septic infection are frequently accompanied by skin eruptions which are similar in appearance to that of scarlatina (see p. 707). This fact doubtless explains the erroneous idea, formerly so widespread, that scarlatina very frequently attacked puerperal patients,* in whom it was thought there existed a peculiar susceptibility to this disease, and for whom a previous attack in early life is said not to be protective to the same degree.

* Martin found only three cases of scarlet fever in 16,000 patients in the Berlin clinics. (Spiegelberg, *Lehrbuch der Geburtshilfe*, 3d edition, 1891).

When it is known that the patient has been exposed to the germs of scarlet fever, and when the poison has entered the genital canal, the vagina may show the redness, swelling, and pseudo-diphtheritic patches ordinarily observed in the throat, and the rash may be most apparent in the region of the vulva. The later occurrence of desquamation when the patient survives will sometimes help to verify the diagnosis.

The *prognosis* is, of course, grave, being very much worse according to the extent of invasion of the pelvic or other organs. The *treatment* is that for the grave forms of puerperal infection.

Erysipelas.—The relation of erysipelas to puerperal infection is even more striking than that of scarlet fever. Barnes¹¹⁷ has said that erysipelas "will perhaps account for more epidemics of puerperal fever than any other external poison." The channel of infection is usually the parturient canal. Of 15 cases observed by Hugenberger, eleven were of the genitalia, two of the nates, two of the face. Winckel saw 36 cases—twenty-eight of the genitalia, two of the breasts, six of the face and scalp. Of Fehling's 5 cases, three were of the face. It is doubtless true that very many cases of puerperal infection are of erysipelatos origin, which, in the absence of the usual symptoms of this disease, cannot be recognized without bacteriological examination. The disease develops more frequently in the first than in the second week after delivery, and death occurs oftener in the second than in the fourth week. The *prognosis* of facial erysipelas in the puerperium is comparatively favorable. When the disease attacks the parturient canal the mortality is high; twelve of Winckel's cases ended fatally. The *treatment* is that for grave puerperal infection.

Diphtheria.—The relation of diphtheria and of other infectious diseases to puerperal infection is similar to that of erysipelas, and the same antiseptic precautions against all infectious diseases are urgently demanded.

Pneumonia ; Rheumatism.—It has been asserted that the puerperal patient is especially predisposed to pneumonia and to rheumatism. These diseases may occur as intercurrent affections, but it is a fact that a septic pneumonia or a septic arthritis, to both of which diseases reference has been made (pp. 703, 707), will account for the relative frequency of the former diseases in the puerperal period. Pneumonia, not of septic origin, occurring in the puerperal period requires no consideration in this work beyond the statement that the course of the disease is more serious than pneumonia in non-puerperal women, the fever being especially high, and the prognosis is distinctly more grave. When secondary to infection of the parturient canal, pneumonia is often of embolic origin, and is frequently observed as a complication of uterine phlebitis or phlegmasia alba dolens. The course and treatment of septic pneumonia are described in the section on *Puerperal Infection*.

A septic arthritis can be differentiated from true rheumatism by the history of the case; by the absence of acid sweats, of cardiac complications, and of marked febrile reaction; and by the fact that one of the large joints, often the knee, is affected; that other joints are very rarely affected in succession; that it has a longer duration and a tendency to ankylosis or to suppuration in the

joint, with general septic infection; and that arthritis is more apt to occur in women who have had gonorrhea before labor. The cause of this so-called "puerperal rheumatism" is probably a specific variety of micro-organism having a predilection for the joints. *Treatment* consists in a careful disinfection of the parturient tract and in keeping the joint at rest, in the application of iodine or ointment of belladonna and mercury to the joint, and, after acute inflammatory symptoms subside, in the employment of cautious passive motion.

Malaria.—Malaria is one of the most important intercurrent diseases of the puerperium, not only because women recently confined have an increased liability to this disease—a fact generally admitted—but especially because this disease so often simulates sepsis, from which it is of the utmost importance that malaria be differentiated. Clinically, women subject to the malarial poison almost always, as the result of the traumatism of labor, manifest this disease after delivery, at which time the type of malaria ordinarily is mild, but exceptionally it may be very severe. The disease usually appears on or about the third day after delivery, and often modifies the course of the puerperal period. While malaria, according to Abelin,¹¹⁸ does not modify the involution of the womb, acute types of the disease, to some extent, predispose to puerperal hemorrhage and to profuse and prolonged bloody lochia.

The influence of malaria upon the milk-secretion is shown by a diminution in the amount of milk secreted, especially when the fever is highest. Whether the germs of the disease are transmitted in the milk to the nursing infant is by no means certain. In some cases it has been asserted that such transmission has been observed.

Diagnosis.—The diagnosis of malaria occurring in the puerperium is often very difficult, and, as stated above, the close resemblance of this disease to some forms of beginning sepsis renders the differential diagnosis the most important feature of malaria complicating the puerperium. A safe clinical rule is to reserve a diagnosis until the parturient tract is known to be uninfected. While frequently the date of appearance is the third day after labor, wide variations are observed. The duration and marked remissions of the fever, its frequent but not invariable periodicity, and especially a morning elevation of temperature; the character of the pulse and the more evident relation of its rapidity to the degree of fever; the blood-examination for the malarial plasmodium; the enlargement of the spleen and of the liver; the quantity and quality of the lochia; and, finally, the efficacy of quinin,—will often assist the diagnosis between malaria and puerperal sepsis.

Treatment.—An early diagnosis is usually difficult, and, in order that beginning septic infection of the parturient canal may not meanwhile gain headway, it is a safe rule to disinfect the vagina, or even the uterus, and to administer a calomel, and later a saline, purge, followed by one or two free doses of quinin (gr. x, administered morning and evening). This course of treatment may further obscure the diagnosis for a time, but it has the advantage of promptly detecting and treating beginning infection, thus avoiding delay in stopping its further progress. If the disease is malaria, the

fever will likely recur, but usually it will readily be controlled by quinin, which ordinarily should be administered in daily doses of from 15 to 30 grains throughout a period of ten days or two weeks. The chart (Fig. 437)

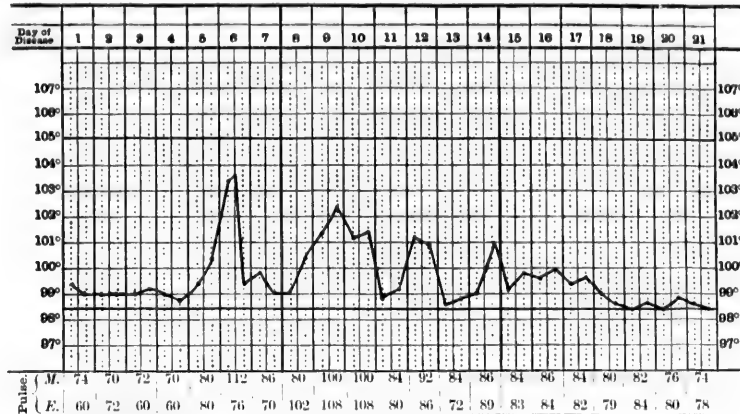


Fig. 437.—Malaria in the puerperium.

illustrates this plan of treatment. The notes of the case are as follows: Sixth day: Tongue coated, conjunctivæ yellow; uterus enlarged, reaching more than halfway to umbilicus; bloody lochia persistent and not offensive; a very large

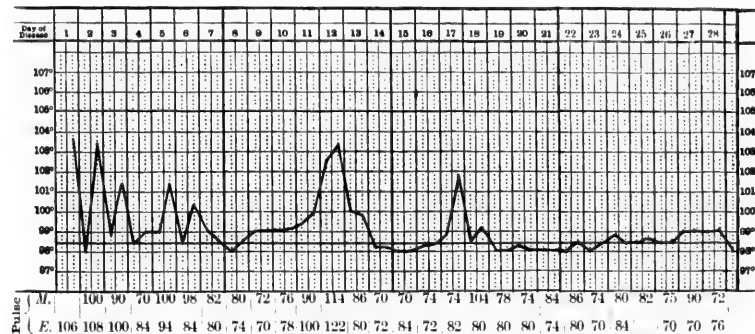


Fig. 438.—Malaria in the puerperium.

amount of healthy decidue and blood-clots removed with curette and placental forceps, followed by douche and gauze-packing; calomel (gr. ij); quinine (gr. x), at night and on the following morning. Ninth day: Temperature again elevated; uterine involution progressing; bloody lochia diminished; quinin, gr. x thrice daily. This dose of quinin was given until the seventeenth day, when cinchonism first appeared, and, as is shown by the chart, the fever disappeared and did not return.

The writer has repeatedly observed a fact recorded by others—namely, that

some puerperal cases of malaria require exceptionally large doses of quinin. The chart (Fig. 438) illustrates this fact. In this case, from the third to the tenth day a daily dose of 15 grains was given, and, the temperature having

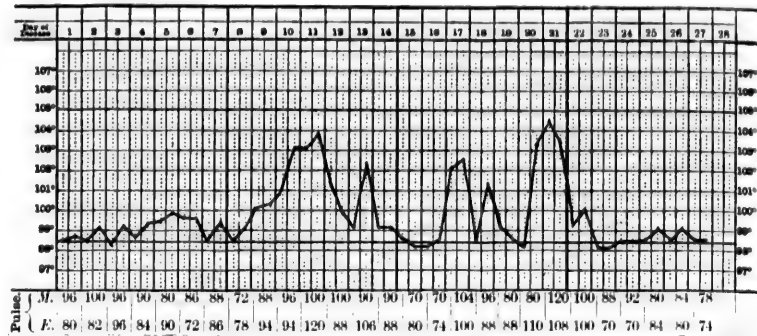


FIG. 439.—Malaria in the puerperium.

ceased to rise, the drug was about to be discontinued. Two days later—on the twelfth day—the temperature rose to $103\frac{1}{2}^{\circ}$ F. notwithstanding the quinin; the daily dose was then doubled, 30 grains being given daily until the fifteenth day, when, the fever apparently being controlled, the amount was reduced to

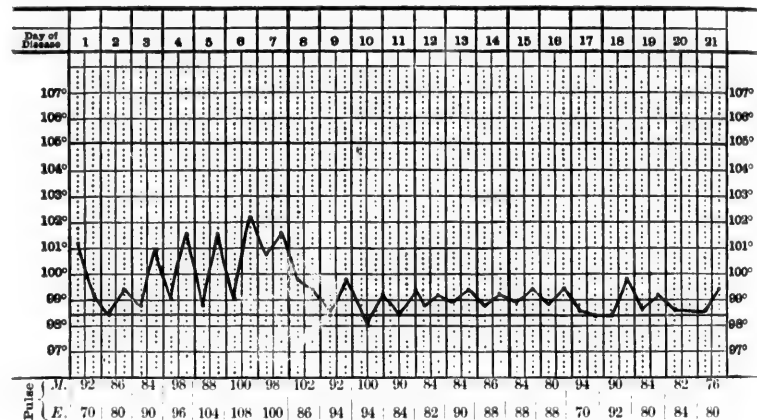


FIG. 440.—Malaria in the puerperium.

15 grains. On the seventeenth day a chill occurred and the temperature rose to $101\frac{1}{2}^{\circ}$ F., whereupon 30 grains were given daily until the twenty-third day, when cinchonism occurred and the temperature became normal; the amount of the drug was then reduced to a very small daily dose.

The chart (Fig. 439) also illustrates the necessity of administering large doses of quinin in some puerperal cases of malaria. Whenever attempt was made to reduce the dose from 10 grains thrice daily the temperature invariably

was elevated, and the fever was finally controlled by administering 20 grains thrice daily (20th, 21st, 22d, and 23d days).

The chart (Fig. 440) exemplifies a milder type of puerperal malaria controlled by a daily dose of 6 grains of quinin.

When it is necessary to resort to large doses of quinin to control malarial fever in the puerperium, the writer's experience agrees with that of Burdel, that the infant is likely to suffer and should be taken from the breast. A daily dose of from 15 to 20 grains has, however, produced no apparent effect. In cases of chronic malarial cachexia with an acute exacerbation after labor, arsenic combined with quinin will often be more efficient than quinin administered alone.

Hemorrhoids.—The interference with the venous circulation of the rectum during the last months of pregnancy very often leaves the rectal veins in a hemorrhoidal condition, which frequently occasions great discomfort during convalescence. Relief may be obtained by free action of the bowels, by the application of hot-water compresses, or, if more agreeable to the patient, by the use of an ice-bag. A piece of cotton saturated with the distilled extract of witch-hazel and inserted partially through the anus, or the use of an ointment composed of equal parts of the ointments of galls, belladonna, and stramonium, will further relieve the pain.

Puerperal Anemia.—According to the investigations of Ingerslev, Fehling, and Meyer,¹¹⁰ the average number of blood-corpuscles and the hemoglobin value of the blood are lessened during the first four or five days of the puerperium, but by the fifteenth day the number of corpuscles and the quantity of hemoglobin have practically returned to normal.

It very frequently happens, however, especially among the poor and ill-fed, that the physiological changes occurring in the blood during pregnancy not only fail to disappear, but even become aggravated under the strain of lactation, and a very marked anemia appears. This impoverished condition of the blood is especially liable to occur when the patient is the subject of any wasting or depressing disease, such as phthisis, chorea, insanity, or when at the time of, or subsequent to, labor hemorrhage or sepsis has occurred. The anemia in such cases may progress, if neglected, to a pernicious form. Careful blood-examinations may be made to observe the effect of treatment, which is usually efficient if not too long neglected. The administration of iron and of arsenic combined with hygienic and dietetic treatment should be kept up for a long period.

3. DISEASES OF THE URINARY ORGANS.

Functional disturbances of the bladder, such as inability to urinate and urinary incontinence, are of frequent occurrence after labor, and are sometimes very troublesome affections, especially incontinence. The loss of power to evacuate the bladder may be due to the inability of the patient to empty the bladder while lying in bed, or to injury of the urethra and the anterior vaginal wall, the resulting edema diminishing the calibre of the urethra and making its course tortuous. Cases of the latter class are usually

permanently relieved by a single passage of a catheter, which straightens the tortuous canal, and when infection of the urethra and bladder does not occur the swelling rapidly subsides and there is no further difficulty. The diminution of intra-abdominal pressure and the relaxed condition of the abdominal walls also prevent the operation of this pressure and the action of the abdominal walls in emptying the bladder; and, further, it is asserted that after labor the bladder-walls admit of greater distention by accumulated urine than can occur during pregnancy. The walls are thus slower to contract in response to the stimulus of the urine in the bladder, and the physiological increase in the amount of urine excreted early in the puerperium soon over-distends the organ. The dangers of over-distention are not only the immediate injury to the bladder—a catarrhal cystitis—but a further and greater danger lies in the fact that the bladder-tissues are thereby rendered less capable of resisting the destructive action of micro-organisms, should the latter effect an entrance. A simple catarrhal cystitis may thus be converted into a serious infective cystitis. The means to be employed for emptying the bladder, and the necessity for chemical cleanliness of the catheter when it is used, have been referred to (p. 660).

Incontinence of urine in the puerpera is often the incontinence of retention. The continual dribbling, however, may be the result of paresis of the sphincter muscle from prolonged labor in head presentation, or it may result from fistulæ. The *treatment* will be governed by the cause. Paresis of the bladder-sphincter very often disappears spontaneously, and recovery can be hastened by the administration of tonics, especially strychnia, and by applications of electricity to the base of the bladder. If a fistula cannot be healed by stimulating applications, such as nitric acid or nitrate of silver, a plastic operation is necessary a few weeks after the patient leaves her bed.

Cystitis and Pyelitis.—The most important organic affection of the urinary organs after labor is cystitis. This disease commonly is mild and of short duration, but it may be a very grave complication when it is due to infection of the bladder. Some cases of septic cystitis assume a most malignant type.

Etiology.—A simple catarrhal cystitis is frequently observed to follow injury to the bladder, either from pressure of the child's head or from over-distention of the bladder. The symptoms in these cases usually disappear in a few days, either spontaneously or after mild treatment. The great danger of the disease is an added infection, for, as pointed out by Bumm, Dubelt, Rovsing, and others, a healthy uninjured bladder can resist the action of micro-organisms; when, on the contrary, a catarrhal cystitis is present, the subsequent introduction of micro-organisms rapidly converts the catarrhal into a suppurative inflammation, which may spread along the urinary tract and finally involve the kidneys, producing pyelitis, pyelo-nephrosis, or nephritis. Ascending infection of the urinary tract usually begins in the bladder, the infecting poison gaining access within this viscus in one of several ways. Commonly the catheter carries the infecting agent into the bladder, either itself not being chemically clean, or, if

properly sterilized, but improperly introduced, it may, at the time of its introduction into the bladder, become contaminated by decomposing lochia. Escaping these dangers, there is yet another danger of carrying into the bladder, on the catheter, micro-organisms commonly found in the otherwise normal urethra. Garonsky,¹²⁰ Rovsing,¹²¹ and others have shown from their investigations that pathogenic bacteria are commonly found in the urethra. Exceptionally infection of the bladder may occur independent of the use of the catheter. Recent clinical and experimental studies of cystitis, particularly by Dogen, Clado, Halle, Albarran, Rovsing, Morelle, Denys, Schnitzler, and Krogus, apparently prove that micro-organisms located in any of the pelvic viscera may find their way into and infect the bladder. The observations of Reymond¹²² are especially interesting. In two cases of cystitis, where the micro-organisms in the uterus and bladder were identical, treatment of the bladder was without result, but after curetting and disinfecting the uterus the cystitis rapidly disappeared. In seven other cases a cure of long-standing cystitis followed removal of the diseased pelvic organs. His four experiments upon animals showed that the introduction of bacteria into the pelvis outside the bladder-walls gave rise to cystitis with the micro-organisms in the bladder, and not in the blood-current of the pelvis. In Wreden's¹²³ experiments, intestinal micro-organisms, or those intentionally placed in the bowel, were found in the bladder.

Very exceptionally the bladder may escape serious inflammation, but injury to the ureters, with subsequent infection, may be followed by inflammatory changes in the pelvis of the kidney or in the kidneys. Labor may also be followed by perinephritic abscesses due either to infection of the pelvic connective tissue, and extension of inflammation by continuity of tissue, or to infection from rupture of a kidney-abscess into the surrounding cellular and fatty tissue.

Diagnosis.—The symptoms of catarrhal cystitis in a puerpera are the ordinary symptoms of irritation and acute inflammation of the bladder. In septic cases the early symptoms are similar; later they are very violent, when exfoliation of the mucous membrane or even of the bladder-walls may occur, and occasion severe tenesmus or retention of urine by obstructing the urethra. Fever is usually moderate so long as the inflammation is confined to the bladder, and gradually disappears after from three to six days. Should this gradual deferescence be followed for ten days or two weeks by an almost afebrile cure, and should the temperature then rise rapidly to a greater height than had previously existed, and be accompanied by pain and tenderness in the region of the kidney, it may be assumed that the pelvis or the parenchyma of the kidney has been invaded. When the temperature from the beginning of cystitis is very high—above 103°—rapid infection of the kidneys has likely occurred.

Examination of the urine will also help to determine the extent of the inflammation by the presence of a large amount of albumin, of renal epithelium, and of casts; and bacteriological examination of the urine will be of further assistance in recognizing those very rare instances of infection of the urinary tract unaccompanied by purulent urine and without marked bladder symptoms.

The time required for the spread of the inflammation from the bladder or adjacent structures along the ureters to the kidneys varies. The usual time is about ten days or two weeks after the appearance of a very mild or severe cystitis. It can, however, in rare cases occur almost from the outset, before or coincident with marked bladder-symptoms and in some cases pyelitis, pyelo-nephrosis, or nephritis becomes apparent only after a long-standing and persistent cystitis or ureteritis.

Prognosis.—The danger of cystitis occurring after labor depends largely upon the promptness and the care exercised in treatment. Neglected cases with ulceration and exfoliation of the bladder will have a mortality of 38 per cent., and of those who recover greater or less permanent damage is done to the urinary organs, from which damage the patient may ultimately die. Pyelitis persisting for months is a not uncommon sequel.

Treatment.—Prevention is of first importance. Catheterization should not be resorted to unless all other means to secure urination fail, such as repeatedly placing under the patient a bed-pan filled with hot water; the sound of running water; assisting the patient into an upright position upon her knees, and pressure over the bladder. While avoiding the catheter, however, the danger of over-distention must not be forgotten, and the catheter must be used, if other means have failed, at intervals of at least twelve hours, but always with strictest antiseptic care. At the earliest appearance of cystitis the bladder should carefully be irrigated every four hours through a two-way catheter with a $\frac{1}{2}$ per cent. creolin solution, or, if this causes much pain, a solution of boric acid (gr. xv to f $\frac{3}{4}$) may be substituted. Warm applications over the bladder and diluent drinks are also to be used. Five- or ten-grain doses of salol three times a day will be of service so long as the parenchyma of the kidneys is not invaded. When constant dribbling from the bladder is replaced by retention of urine, occlusion of the urethra by an exfoliated portion of the bladder should be suspected, and the separated portion should be removed, dilating the urethra for this purpose if necessary. Large doses of iron, inhalations of oxygen, and the free use of stimulants constitute the general treatment on which most reliance can be placed when the patient is profoundly septic.

The treatment of *pyelitis* following labor will depend upon the character of the disease. In mild cases it may be sufficient to obtain drainage by the administration of diuretics that act mechanically, such as large draughts of water, and to attempt disinfection of the urinary tract by the administration of salol or boric acid in doses of 5 or 10 grains every four hours. For sub-acute or chronic cases alterative and stimulating diuretics will be useful. Cases that do not respond promptly to these milder measures should be treated by surgical means to obtain free drainage. When a distinct collection of pus in the region of the kidney is detected by palpation, the most efficient treatment is incision in the loin and the introduction of a drainage-tube, which should be removed when disappearance of the purulent discharge and shrinkage of the cavity indicate that active inflammation has subsided. When palpation fails to detect swelling in the region of the kidney, when there is doubt as to

which kidney is affected, or especially when vaginal examination finds a thickened, tender ureter, catheterization of the ureters will be useful for both diagnosis and treatment. By means of the ureteral catheter and an aspirating syringe the pus should be drawn from the pelvis of the kidney at intervals of a few days, the quantity withdrawn should be noted, and the same quantity of a weak antiseptic solution should repeatedly be forced through the catheter and withdrawn. The treatment by incision in the loin is less tedious, and does not require the special appliances and skill necessary for catheterization of the ureters; moreover, should the fever and the albuminous and purulent urine be due to small multiple abscesses in the parenchyma of the kidney, the opening in the loin is more favorable for diagnosis and treatment.

Albuminuria.—Albumin is very frequently found in the urine during the first forty-eight hours of the puerperium, its occurrence at this time being considered physiological. Trautenroth¹²⁴ asserts that during labor albuminuria is the rule, its absence the exception, and that in from one-fourth to one-third of the cases casts are present. Both casts and albumin promptly disappear early in the puerperium, and their presence after the first week usually means catarrh of the urinary tract or more serious disease.

Etiology.—Various explanations have been offered for the occurrence of albuminuria at a later period of the puerperium. The most plausible theory is that in cases apparently passing through a physiological puerperal period the presence of albumin in small quantity indicates a continuation of the kidney condition which was present during the latter months of pregnancy. To those who consider the kidney of pregnancy due to the excessive amount of work thrown upon the kidneys throughout the period of gestation, the similar demands upon the excretory organs during the lying-in period readily explain the continuance of small amounts of albumin in the urine of the puerpera. The frequency of albuminuria due to a continuation of the kidney of pregnancy has frequently been demonstrated by autopsy, the kidneys presenting the same condition of anemia without inflammatory changes. Albuminuria in the puerperium is very often a concomitant symptom of infection arising from the genitalia. There may be either a simple catarrhal inflammation, or, when infection is at its height, true parenchymatous nephritis may be present, caused by the excretion of micro-organisms or their toxins, the toxins acting upon the tissue of the kidney practically as mineral poisons. In even more advanced cases of puerperal sepsis metastatic abscesses in the kidneys may occur. It has been asserted that the albuminuria increases and diminishes with the pelvic lesions of septic infection. Sirédey considers puerperal nephritis a constant complication of puerperal uterine phlebitis or lymphangitis. The author has observed nephritis with albuminuria and casts develop on the fourteenth day of the puerperium in a patient with a very virulent mammary abscess.

The prognosis of puerperal albuminuria is determined by the cause. When due to the persistence of the kidney of pregnancy, the small amount of albumin slowly but completely disappears. The symptoms of the kidney-lesion in

septic cases are usually obscure, and are often overshadowed by, and disappear more slowly than, the uterine symptoms. The possibility of thus explaining the very rare occurrence of eclampsia so late as two weeks or longer after labor should not be forgotten. Whether the kidney disease persists in kidneys previously normal is also determined by the cause and by the extent of injury done to the tissues of these organs. The occurrence of albuminuritic retinitis and blindness in the puerperium would indicate an old nephritis antedating the pregnancy. It should be remembered, however, that loss of vision may occur after labor wholly independent of kidney disease. Very rarely temporary blindness may occur from vaso-motor disturbance of the vessels of the retina. The loss of vision may also follow severe hemorrhage, and permanent blindness may result from septic panophthalmitis.

Hematuria.—Bloody urine is sometimes observed soon after labor. Serious contusion of the bladder during labor, either by the child's head or by forceps, will occasionally be followed by this symptom. Ordinarily the blood in the urine is due to the persistence of vesical hemorrhoids which developed during pregnancy. The differential diagnosis is made by the history. The hemorrhoidal condition, as a rule, disappears spontaneously and usually requires no treatment, although exceptionally it may be necessary to employ astringent injections into the bladder. When bloody urine from injury to the bladder is present, especial antiseptic care should be observed should the use of the catheter be required. The possibility of the occurrence of fistulæ should not be overlooked.

4. DISEASES OF THE NERVOUS SYSTEM.

Cerebral Hemorrhage and Embolism in the Puerperium.—Intracranial accidents so serious as hemorrhage or embolism are fortunately very rare, and often are only incidental complications of the puerperium. A woman predisposed to cerebral hemorrhage would *a priori* be more likely to be stricken with this accident either during pregnancy or at the time of labor. Throughout the period of gestation the changes in the blood, the physiological hypertrophy of the heart, and the accelerated destructive changes of any pre-existing kidney-lesion all combine to offer a favorable opportunity for cerebral apoplexy. Or, having passed through pregnancy safely, the physical strain of labor would tax to their utmost the cerebral blood-vessels. Hemiplegia after an eclamptic attack is a familiar illustration of diseased blood-vessels giving way under sudden and extraordinary pressure. In the puerperium, on the contrary, the circulation at once becomes more quiet, arterial tension decreases, and the danger of cerebral apoplexy correspondingly diminishes. This explanation of the relative frequency of apoplexy occurring during the child-bearing period is borne out by statistics.

The increased relative frequency of cerebral embolism in the puerperium is to be found in the fact that sepsis, either as endocarditis or as phlebitis, is a factor of great importance in the etiology of cerebral embolism in puerpere.

The clinical features and prognosis of cerebral hemorrhage are in no respect

different from the disease as it appears apart from child-bearing, and therefore need no further consideration here beyond the statement that a paralyzed pregnant woman can pass through her labor without her uterus sharing this loss of power.

Cerebral embolism also has the same clinical manifestations in the puerpera as in others, its symptoms depending upon the size and distribution of the vessel involved, hemiplegia, monoplegia, or aphasia developing according to the trunk or branch of the vessel receiving the embolus. It should be borne in mind that paralysis in a pregnant or puerperal patient is sometimes, although rarely, hysterical, and a critical diagnosis should therefore always eliminate hysteria. Within a year the writer has seen a case of hysterical aphonia in a pregnant woman whose mother was similarly affected. Immediately after labor the difficulty at once disappeared. It is suggestive, as Lloyd remarks,¹²⁵ that a large proportion of reported cases of paralysis in pregnant women appear to be cases of aphasia. The diagnosis of hysterical paralysis is usually not difficult when the inconsistency of some of the physical signs and the characteristic mental and moral symptoms are recognized. Hemianesthesia, more or less involvement of the special senses, the loss of voice rather than the inability to use words properly or to comprehend them, the presence in only slight degree of exaggerated knee-jerk and contractures, the absence generally of marked involvement of the face, of ankle-clonus, and of bed-sores, will at once arouse suspicion of the hysterical origin of the disease.

Neural and Spinal Affections Following Labor.—Various forms of paralysis are sometimes observed to follow labor. Frequently a transient loss of power in one of the lower extremities either is overlooked or is attributed to rheumatism or to unimportant pressure on a nerve-trunk; the inconvenience, it is thought, will soon disappear, and no further attention or treatment is directed to a condition that is by no means trifling, and one that in some cases proves a most disastrous sequel to childbirth.

The etiology of neural affections following labor may be grouped conveniently in two general classes: (a) Nerve-injuries due to pressure by the child's head or by forceps; (b) Disease of the nerves due to septic infection.

Of the first class, there is a type of cases, due to slight injury, with only partial and temporary loss of power accompanied by some pain and discomfort, all of which symptoms disappear before the patient leaves her bed, the enforced rest of the puerperium being sufficient for nature's recuperative power to effect a complete cure. This grade of injury is of not very great clinical importance.

A very important nerve-injury following labor is one producing paralysis from traumatism of the sacral or lumbar plexus, this type of paralysis, as pointed out by Mills¹²⁶ and by Hünemann,¹²⁷ being usually peroneal, and commonly associated with severe neuritis. The great frequency of involvement of the peroneal nerve is explained by the anatomical situation of its origin. The roots of the sacral plexus lie upon a cushion of muscle, but the lumbo-sacral nerve, arising from a portion of the fourth and from the fifth lumbar nerve, soon passes over the bony pelvic wall at the linea innominata, where it is

exposed to injury by the child's head entering the pelvic inlet. This lumbo-sacral nerve is mainly the root for the peroneal nerve, and clinically it has been found that the paralysis of motion due to traumatism during labor is often a loss of power of the muscles supplied by this nerve. In other words, the type of paralysis in these cases is commonly an inability to dorsal-flex the foot, extend the toes, and evert and rotate the foot outward. Sometimes there is also inability to rotate the thigh inward and draw it forward—movements controlled by the superior gluteal nerve. This additional loss of power will be understood when it is remembered that the superior gluteal nerve arises from the posterior part of the lumbo-sacral cord, and is therefore sometimes affected coincidently with the lumbo-sacral cord or is secondarily involved by the spread of inflammation. In other cases the loss of power becomes more general, the inflammation in the nerves extending throughout the entire extremity, and even to the other limb, or along the nerve-trunks to the cord, attacking the ganglion-cells of the cord, with the development of trophic changes.

The class of cases most likely to be followed by serious nerve-injuries from pressure are usually cases of pelvic deformity, in which the injury is produced by direct pressure of the child's head. Hünemann has shown that injuries more frequently follow labor delayed by a generally-contracted pelvis. In the simple flat and flat rachitic pelvis there is more space in the oblique diameters, and the nerve-trunk is thus less exposed to pressure, the prominent promontory of the sacrum giving the pelvic inlet a pronounced cordiform shape, the hollow or bay to the sides of the promontory offering greater protection to the nerve-trunks. Exceptionally these injuries may follow labor when the pelvis is normal, but the presentation is abnormal—as a face or a brow presentation—the abnormal presentation offering larger diameters and thereby increasing the area of pressure. Nerve-injuries are also sometimes to be attributed to forceps. On the one hand, failure to use the instrument in proper cases when labor has been unduly prolonged, and on the other hand pressure upon the nerve-trunks during extraction or by pendulum movement of the blades, are factors in the production of the injury to the nerve that sometimes follows a difficult forceps delivery. It is usually not easy to determine which is more to be blamed for the injury received—the child's head or the forceps. To assist in determining this question Mills¹²⁸ has called attention to an important fact—namely, that the pressure caused by forceps is more often followed by injuries of the second and third, and even lower, sacral nerves, and therefore the muscles supplied by the internal popliteal—the posterior muscles of the calf—are paralyzed, rather than the muscles supplied by the peroneal nerve.

Neuritis due to septic infection may manifest itself in protean types, just as is observed in neuritis due to any toxic agent: it may be multiple or diffused, or a single nerve may be involved; it may be partly or chiefly in the upper extremities. When the upper extremities are affected, the terminal branches of the median or ulnar nerves, or of both, are commonly involved, and both motor and sensory fibres are affected. In a case recorded by Möbius,¹²⁹ in which the neuritis attacked the legs as well as the arms, the tendon-reflexes were

active, the interosseous muscles were atrophied, and both hands were the seat of a burning, pricking sensation. The cranial nerves were not affected. Fever and other signs of infection were present. Not infrequently the predisposing causes of neuritis under other circumstances, such as alcoholism, syphilis, and exhaustion, are predisposing factors in the development of septic neuritis following childbirth. The lowered vitality and the depressed nervous force of the puerpera render her nervous system an easy avenue for the inroads of sepsis.

The symptoms of septic multiple, diffused, or isolated neuritis are not different from the symptoms of neuritis from other causes. Pain, hyperesthesia, paresthesia, and paralysis or pseudo-paralysis are commonly present. Sometimes there is anesthesia, and often there are changes in the reflexes with cramps and contractures. Atrophies and the reactions of degeneration are occasionally present.

As a means of differentiating traumatic from septic cases it is noteworthy that the symptoms of septic cases usually appear in the first, second, or third week after labor, although they may occur earlier or later.

A form of neuritis following labor, of considerable importance and involving primarily the nerves in the pelvis, is that sometimes recognized by the gynecologist a long time, it may be, after a labor that was followed by traumatism or by mild infection. In such cases there has been left in the pelvis inflammatory exudate in which a nerve-trunk or nerve-filaments are imbedded; by reason of either the spread of infection to the nerve-sheaths or the constant pressure of the exudate and the displaced pelvic viscera more or less pelvic pain and even loss of power are produced.

Neuritis and paresis of septic origin are not infrequently associated with septic phlebitis. The intense pain and the loss of power sometimes observed to accompany and to be a sequel of phlegmasia alba dolens have been considered due to the accompanying neuritis. The occurrence of gangrene in phlegmasia has also been attributed in part to neurotrophic changes, and has been thought to be not wholly the result of an occluded circulation. Septic myelitis has been observed to complicate or follow phlegmasia and to give rise to a paraplegia. Paralysis of a greater or lesser degree following phlegmasia has been recorded by Mauriceau, Boer, Casper, and Gittermann (quoted by Winekel).

When the spinal cord is attacked by the ravages of general septic infection, the clinical and pathological evidences of the myelitis commonly show very numerous and disseminated foci of infection.

Paralysis of reflex and hysterical origin in the puerperium has been described by most authors. Barnes refers to the shock of labor, exhausting the spinal centres, as a cause of reflex paralysis, and quotes Brown-Séquard's belief that retroversion may also cause reflex paraplegia. It is probable that many of the cases thought to be reflex are in reality due to the extension of the inflammation to the cord or are to be attributed to sepsis, the toxic agent reaching the nerve-centres and nerve-tracts through the circulation.

Although hysterical paralysis may readily occur in a puerpera, the profound nerve-changes throughout pregnancy and in the puerperium being sufficient to awaken functional disturbances in individuals previously predisposed to nervous disorders, it should never be forgotten that organic disease may be present, and that a careful and scrutinizing examination may bring to light something more than hysteria.

Treatment.—Rest in bed is of the greatest importance in the treatment of neural affections following labor, when, as is frequently the case, a greater or lesser degree of neuritis accompanies the loss of power. The pain should first be relieved by the appropriate treatment for neuritis—absolute rest, alternate hot and cold applications, ointments of mercury and atropin, the internal administration of sodium salicylate or salol; the further relief of pain by phenacetin or, if necessary, by opium. Later, the iodids, and, after the pain has been relieved entirely, active electrical treatment and massage, should be employed. Pelvic inflammation should be treated systematically over a sufficiently long period in intrapelvic cases. In all cases appropriate general treatment, including strychnia and quinin, must not be neglected.

Insanity in the Child-bearing Woman.—*Frequency.*—The statistics of asylums in which mental derangements have been classified as following reproduction show considerable variation, due to a diversity of factors, such as nationality, social condition, reliability of history, etc., that cannot be analyzed here. It is sufficient to say that in from 8 to 10 per cent. of all insane females the disease developed in the child-bearing process, and that, on an average, one woman of four hundred confined becomes insane. The disease declares itself most frequently in the puerperium, usually within the first two weeks (Esquirol 66 per cent., Toulouse 75 per cent., within the first ten days), and in many cases prodromic symptoms have been present at some time during pregnancy. Next in frequency is the period of lactation, at any time of which period insanity may appear, although it is usually manifested toward the latter half. The insanity of lactation is more common in multiparæ. The insanity of pregnancy, the least frequent of all, usually begins after the fourth month, and is of about equal frequency in multiparæ and in primiparæ.

Etiology.—It is customary to classify the causes of insanity in its relation to reproduction as predisposing and exciting, and very many conditions have been arrayed as belonging either to the one or the other class. It should be borne in mind that in each individual case many factors are indissolubly associated, the patient's mental break-down being the resultant of several complex conditions, each reacting upon and intensifying the others.

Of predisposing elements common to the three varieties of alienation under consideration, the most important is hereditary predisposition, which is found in from 25 to 30 per cent. Since this is about the proportion found in insanity generally, it is evident that heredity is not of greater importance in the puerperal forms; indeed, some statistics show it to be of less importance. Of importance also are other neuroses, such as chorea, epilepsy, and hysteria. Alcoholism and the pre-existence of insanity are also frequently predisposing factors.

A woman with an unstable nervous system from any cause is handicapped in her passage through the nerve-exaltations and storms that await her throughout the course of pregnancy, labor, and lactation. Individual inhibitory power will have much to do with the final issue, and if this power is not sufficient to withstand the varied determining factors of mental disease, insanity is to be expected.

During pregnancy the most important exciting cause is probably toxæmia, by which is meant a condition of the blood so surcharged with and changed by toxic organic principles, the result of faulty metabolism and excretion, as to render the blood incapable of proper nutrition. In the pathology of pregnancy the great importance of these changes has been insisted upon (see p. 202). The effect of faulty elimination of secretions altered in quality and quantity plays an important rôle in the production of the unstable nervous system of pregnant women, and we are not, therefore, surprised almost invariably to find, preceding an outbreak of insanity, constipation, incapacity of the liver to perform the work thrust upon it, and failure of the skin and the kidneys, with or without albuminuria, all of which certainly can and do induce faulty nutrition of the brain. Of less importance, but contributory more especially to the insanity of pregnancy, are moral factors, such as mental anxiety from domestic worry, desertion, or seduction. The exciting causes of insanity in the puerperal period have variously been stated to be sepsis, anæmia, dystocia, post-partum hemorrhage, eclampsia, great exhaustion, and profound emotion, and in individual cases one or more of these causes is usually discoverable. The employment of instruments and anesthetics during labor has not been included as a cause, for the reason that their more general employment without a proportionate increase in mental derangements, and their capacity to relieve the suffering which otherwise must react unfavorably upon the individual's nervous force, seem sufficiently plain to consider them prophylactic rather than exciting factors.

The relative importance of the causes just enumerated is difficult to determine, a study of statistics furnishing but little light on the subject. The opinions of various authors are apt to reflect the class of cases they have individually seen, and as insanity, after all, is not so very frequent, an individual's experience must be too small to warrant general conclusions. In recent years, however, the conviction has steadily been growing that sepsis bears a far more frequent and important relation to the insanity of the child-bearing woman than has hitherto been thought. This statement, if true, is of greater significance to, and calls for closer attention on the part of, obstetricians than alienists, since to the former the immediate or remote results of infection must and should always have a deeper interest. If the toxæmia of pregnancy is, as it appears to be, an important element in the insanity of pregnancy, how much greater will be the tendency of an unstable nervous system to lose its equilibrium when, overtaxed by faulty excretion during pregnancy, there is encountered the additional strain of the puerperium, when the organs of excretion for a time have new demands upon them, and when opportunities for septic

absorption, in size of the dose and in the virulence and intensity of the poison, are without parallel in the whole period of the reproductive function !

There are many facts to support the belief that sepsis is by far the most important cause of the puerperal forms of insanity. First, let us study the statistics of recent years. In 58 cases Holm noted severe puerperal processes in thirteen ; Hansen attributed forty-two of 49 cases to infection ;¹³⁰ in 40 cases Clark observed eight with septicemia and eleven others with inflammatory disease of the uterus and appendages.¹³¹ Hansen places the proportion of toxic cases at 86 per cent. ; Idanof, at 66 per cent. ; Lallier,¹³² at 70 per cent. Olshausen in his classification of puerperal psychoses assigns the first place to the infectious types.¹³³ Menzeis remarks that most alienists allow that some puerperal cases are of septic origin, and he further says that it is strange no one has ventured to assert that all puerperal cases are due to intoxication from either bacteria or toxemic organic compounds. Rohé¹³⁴ asserted his belief that few cases of puerperal insanity occur without preceding or coincident puerperal infection.

A close analysis of the symptoms and course of the affection gives additional support to Rohé's notion. From the fifth to the tenth day—the usual time of appearance after labor—is commonly the period in which sepsis is manifested. In unquestionable septic cases the simultaneous appearance of the mental and local disorders and the aggravation of mental symptoms that may have pre-existed are surely significant. Again, the largest proportion of cases are maniacal with elevated temperature. Clark¹³⁵ says : " Rarely was a case admitted that did not exhibit uterine or allied symptoms of abnormal character, the most frequent being pain on pressure in the hypogastrium, and scanty, extremely offensive lochia." Menzeis remarks that the improvement which follows when the lochia, having ceased, return ; the invariably delayed involution of the womb ; the quick production of anemia and profound blood-alterations with wasting ; the benefit from purges ; the widespread objection to opium ; and the improvement from local uterine treatment,—all testify to the septic character of the disease and point to a primary blood-condition rather than a cerebro-cortical condition. He further believes that this poisoned blood can cause, in certain individuals of low compensation, changes in the chemical constitution of cells, by which changes nerve-energy is disordered and insanity is produced, the type and result being dependent upon the products of inflammation and the degree of their absorption.

Pathological evidence is not wanting to substantiate further the septic origin of the insanity of the puerperium. As will be pointed out later, no distinctive pathological changes in the brain have yet been found to demonstrate satisfactorily the etiology of the affection ; whereas, on the contrary, the pathological findings in the pelvic organs of acute cases are almost invariably those of infection, and in chronic cases the remote results of sepsis are often apparent in old inflammatory pelvic disease. Autopsy-records for which the most scrutinizing anatomical and microscopical investigations of the brain and the spinal cord have been made are frequently summarized, as in the case most minutely

and carefully studied by Feist,¹³⁶ in which case the brain-examination was negative, while the spinal cord showed in the posterior columns the lesions produced in this location by toxic agents. The writer is not aware of any extensive chemical or micro-chemical investigations with the view of shedding more light on this subject, but recent advances in bacteriology warrant the belief that some day proof will be abundant of the universal belief that either toxemia or septic infection is a primary factor in all the psychoses of childbirth.

As determining elements of lactation cases, anemia, prolonged lactation, repeated child-bearing, or other bodily conditions productive of exhaustion are most important; and among these the remote effects of sepsis also should have a place.

Pathology.—Numerous pathological changes have been found in the bodies of those dying with puerperal insanity, but, as has previously been stated, none of these changes offers a wholly satisfactory explanation for the morbid processes of the brain. Congestion of the brain and its membranes is usually found in the more active types, and in evident septic cases inflammatory changes with capillary emboli have been observed. In other cases the brain-substance has been pale, and in some chronic cases its convolutions were shrunken. The evidences of anemia throughout the body were widespread.

Symptoms.—The forms of psychical disturbance met with are mania with or without delirium, melancholia, and dementia, the latter being the final stage of cases that become chronic. Mania and melancholia are the prevailing types, mania being the most frequent type and occurring oftenest in the puerperium, and more often in lactation than in pregnancy. Melancholia is more common in pregnancy, at which period active delirium is very rare.

Insanity of Pregnancy.—In a large proportion of cases of insanity of pregnancy the alienation is of a mild type and is preceded by prodromal symptoms. The physiological changes in the nervous system characteristic of pregnancy are heightened. The alterations in disposition, the irritability of temper, the peculiar whims, and the depression are often followed by a condition of high nervous tension with loss of memory and of self-control, and after a period of insomnia the condition gradually merges through sadness, distrust, and apprehension into established melancholia. The patient becomes reserved and indisposed to mingle with her friends or her family, and is distrustful of all around her. Religious or erotic impulses may develop, and efforts at self-destruction may be made on account of an imagined unpardonable sin. This tendency to commit suicide calls for constant watchfulness. The patient may indulge in lewd and obscene language or may make improper overtures to male acquaintances. Active delirium occurs in rare cases.

Insanity of Labor.—Every obstetrician has observed the varied capacity of his patients to endure the agonies of childbirth, and there are but few who have not witnessed, in individuals practically maddened by their supreme suffering, acts of nervous exaltation, which force the conviction that for the time mental inhibition is lost and that the patient is no longer responsible for her acts. Without previous indication for the use of an anesthetic the writer has

observed, as did Hervieux, a patient rise suddenly from her bed, and with wild screams attempt to jump from her bedroom window. In another case the patient's loud cries of "Help!" "Murder!" brought to hand two officers whose protection the writer was compelled to claim against the fury of an ignorant husband. Usually and fortunately, the insanity of labor disappears after delivery. Its treatment should be the termination of labor by forceps or by version under anesthesia when labor is unduly delayed.

Insanity of the Puerperium.—When the disease develops at the time, delirium is common, particularly in the cases occurring early—before the fourteenth day. Here also there are in at least half the cases closely observed prodromal symptoms during pregnancy. These symptoms may have been overlooked, or the onset may arise with startling suddenness accompanied by suicidal or homicidal tendencies. Fever, which is commonly present, may be very high in severe septic cases. If the patient is maniacal, which is the most common type, she is sleepless and violent and attempts to destroy those around her. There are delusions and hallucinations. The ideas and language of the patient flash from her with remarkable rapidity and incessant change. Now sensuous, obscene, profane, and making attempts at self-exposure, in an instant she may revert to religious ideas, to indulge in prayer and the singing of hymns. In one case, that of an illegitimately pregnant colored girl of nineteen, the writer was thought to be the Almighty, from whom the girl piteously besought pardon for her sins. The next moment, while counting her pulse, he was assailed upon with a frenzy from which he barely escaped, the patient, now terrorized by his presence, believing him to be Satan himself, upon whom she spat with fury. Within a very short time he left her singing a Sunday-school song, which was soon followed by word-pictures of obscene situations mingled with revolting profanity. Melancholia in the puerperium occurs less frequently than mania—usually after the fourteenth day—and it is very apt to be accompanied by persistent attempts at suicide, requiring unremitting watchfulness on the part of attendants. Delusions involving frequently the husband's fidelity, and hallucinations of sight and hearing, are commonly present.

Insanity of Lactation.—Mania and maniacal delirium are comparatively rare in this type of insanity. The patient is usually melancholic, quiet, listless, and depressed, with frequent delusions of persecution. In the later stages the mental faculties are at a low ebb, dementia supervenes, and the patient can with difficulty be aroused from her listless, almost lethargic, condition.

It should be borne in mind that any type of childbirth insanity may occur at any period of the child-bearing process. In the preceding description an attempt has been made to give a brief outline of the symptoms of the type most frequently met with in each period. A classification of the type independent of the periods of occurrence, very convenient and practical for closely studying the progress of symptoms in individual cases, is that made by Menzeis,¹³⁷ based upon the fact that any given case may pass through six stages—namely: (1) Prodromal disturbance; (2) early delirium; (3) melancholia; (4) stupor; (5) mania; (6) dementia.

Diagnosis.—Usually there is no difficulty in recognizing the various types of insanity in the child-bearing woman. The delirium of fever or delirium tremens complicating the puerperium might offer some difficulty at the onset of the symptoms. In the former case it will sometimes be necessary to wait for the decline of the fever before reaching a definite conclusion, and in the latter the history will go far toward clearing away any doubt.

Prognosis.—As a general statement, it may be said that about two-thirds of all cases recover within five or six months; of the other third, from 2 to 10 per cent. die from septic infection, exhaustion, or intercurrent diseases; the rest remain permanently insane. Viewed with reference to the period of occurrence, the insanity of the puerperium, particularly the nearer to labor it occurs, shows the largest percentage of recoveries, while that of pregnancy is least favorable, excluding from the latter the very mild cases of early pregnancy in which the symptoms are merely an aggravation of the ordinarily considered physiological changes of gestation. In Menzeis' cases the recoveries were as follows: In pregnancy, 43.3 per cent.; during the puerperium, 75 per cent.; during lactation, 56.5 per cent. Melancholia is more favorable than mania in pregnancy, while the reverse is true in the puerperium.

The type of the disease, however, is of as great importance as the period of its occurrence. The life of the patient is in greater danger from mania, while her mental faculties are more likely to be disabled or permanently lost from melancholia, in which type there is also a longer duration.

Again, the older the patient, the greater the number of pregnancies, and the more depression with extreme rapidity of pulse and persistent elevation of temperature, the graver is the prognosis. Intemperance also adds a risk to the disease. In cases clearly due to infection and in those in which hereditary predisposition to nervous disease is largely absent the duration is shortest and the outcome is most favorable (Toulouse). When eclampsia bears a causal relation to the puerperal form the prognosis is distinctly more favorable, the patient recovering sooner than in any other variety (Hoppe).¹³⁸ The causes of death in fatal cases, apart from sepsis, which certainly is found in a large proportion, may be intercurrent or pre-existing disease, especially of the lungs, the kidneys, and the heart. According to Menzeis, tubercle is found in one-third of the cases, not so much arising from family predisposition as from following a traumatic pneumonia due to forced feeding and stupor.

Treatment.—It is generally agreed that practically all cases of puerperal insanity should be asylum patients; that as such even the milder cases are better cared for, and that convalescence is more rapid and complete, is the belief of most alienists. An additional reason for asylum treatment is found in the fact that even these milder forms may develop into graver ones with unexpected suddenness. When delirium and suicidal or homicidal tendencies are present there is no adequate security to the patient, her family, or her attendants outside the walls of an asylum.

Contrary to the best advice, the family and friends often insist upon keeping the patient at home, and are unwilling to be instrumental, as they say, in en-

grafting upon the patient's future existence the popular and unfortunate stigma that attaches to the briefest sojourn in a lunatic asylum. Therefore it has been thought appropriate to outline briefly the indications in managing these cases. Skilled attendants with experience in caring for insane patients should always be secured. Absolute rest, quiet, and isolation must be obtained, and even members of the immediate family should not be permitted access to the patient.

As the treatment of insanity generally is largely symptomatic, so in the childbirth form measures directed to the improvement of the patient's general condition are to be employed, together with special treatment for symptoms and complications that may be present in individual cases. The general treatment is all-important. Its aim should be, first, to correct disordered states of the hepatic and gastro-intestinal functions, so commonly present, in order to ensure the proper digestion and assimilation of food. An opening enema, followed by courses of a mercurial with a subsequent saline, is generally the routine beginning in asylum practice. Proper and sufficient food, usually liquid and often predigested, together with moderate stimulation, is of paramount importance. The quantity of stimulants to be employed in individual cases is best determined by principles similar to those which govern their use in "typhoid" states. Forced feeding by the esophageal tube should be resorted to only when absolutely necessary, and it may be replaced at intervals by nutritive enemata. The almost constantly associated depraved condition of the blood clearly calls for the use of iron and arsenic, which may be given in the form of Bland's pills and Fowler's solution. The combination of the "four chlorids" is a particularly valuable preparation. Often there must be selected preparations of iron that are least likely to disorder the gastro-intestinal secretions, such as the albuminates. Nerve-sedatives are not to be used indiscriminately. Nutrition is the indication, not sedation. Bromids are of little value except in cases in which hysteria of sthenic type is prominent. Opium in any form is generally not to be employed, especially on account of its action upon the secretions. When it is necessary to procure sleep, alcohol, chloral, or paraldehyd is preferable. To reduce high temperature, quinin and cold, the latter either as a pack or as a bath, are to be employed.

In view of the growing belief that pelvic inflammations of septic origin are of greatest importance in the etiology of the puerperal forms of the disease, a careful study of the uterus and its appendages should always be made in this class of cases, and usually local antiseptic treatment is to be employed. Clark remarks: "In no class of cases is gynecological investigation of more importance than in the study of puerperal insanity."¹³⁹ In many cases operative means will afford relief and even cure—a fact urgently insisted upon by Rohé.¹⁴⁰ Such radical treatment, to accomplish its best result, must not be delayed too long. That it is practically futile to remove old diseased appendages for the permanent relief of long-standing nervous affections is an axiom begotten of desperate struggle between gynecologists and alienists.

When the milk-secretion has not disappeared spontaneously, measures

should at once be taken to accomplish this end, and watchful care must be exercised to prevent the occurrence of mammary abscess.

While the patient is kept in bed the great liability to the formation of bed-sores should be borne in mind, and efforts should be made to prevent their occurrence. In chronic cases, and in acute cases after the subsidence of urgent symptoms, out-door exercise in the company of a watchful attendant should be insisted upon and be graduated to the patient's strength.

Acute Tympanites.—In neurotic women enormous accumulation of flatus is sometimes observed in the puerperium. The distention of the abdomen may not only occasion great distress, but, when it is accompanied by complete paralysis of the muscular coat of the bowel, with persistent vomiting and obstinate constipation, such as are seen in intestinal obstruction, there is also imminent danger to the patient's life, a termination of which being avoided by most active treatment of the condition. It should be remembered that this acute paralysis of the intestines occurs without any signs of peritonitis or other evidences of infection, the symptom apparently being due to a purely nervous influence. Large doses of strychnia administered hypodermatically are indicated, and, should the patient's distress not promptly be relieved by rectal injections of asafetida or by the introduction of a rectal tube and by the application of a firm abdominal binder from the trochanters to the ribs, the large bowel may be punctured through the abdominal wall, or the abdomen may be opened and the intestines be incised and stitched at several points.

IV. RAPID OR SUDDEN DEATH IN THE PUERPERIUM.

No accident can happen to a woman that carries with it so much horror as rapid or sudden death at any period of the puerperium, and no physician, however great his reputation, can escape the criticism which invariably follows even when this accident is absolutely beyond his control. He should always know the causes of rapid or sudden death in the puerperium, and by explaining the utter impossibility in most cases of foreseeing or combating the death he can partially avert unjust and unkind criticism. It is desirable in this work to omit the detailed histories of cases of sudden death that have been recorded in the literature of obstetrics, the most important causes of this accident only being here enumerated. The causes of rapid death may properly be separated from those of sudden death, since rapid death will usually be preceded by an accident or grave disease which will enable the physician to foretell the probable occurrence of death, while sudden death comes with a lightning-like stroke and without a moment's warning to a patient often previously enjoying apparent health.

The causes of *rapid death* in the puerperium may be any of the following: Accidents of labor, such as hemorrhage and shock following placenta previa, accidental or post-partum hemorrhage, rupture or inversion of the uterus; rupture of a hematoma situated either externally on the vulva or within the pelvic cavity; rupture of peritoneal adhesions or of a broad ligament or an

ovarian vein; acute purpura hæmorrhagica; cerebral embolism or apoplexy; hæmoptysis; pre-existing diseases of the respiratory or circulatory system so grave as not to withstand the strain of labor, which is followed by extreme exhaustion and rapid death.

Analyses of the recorded cases of *sudden death* include the following causes: Heart failure which has resulted from rupture of the heart due to fatty degeneration, to a patch of fibroid degeneration, to acute myocarditis. Sudden arrest of the heart's action has followed a primary thrombosis in the right side of the heart, the thrombus extending into the pulmonary artery, or more frequently the cause of death has been embolism of the pulmonary artery. Rupture of a cyst in the auricular septum of the heart, of an aneurysm, of the aorta itself, and an attack of angina pectoris have caused immediate death. Mental emotion, such as a profound impression of sorrow, of joy, of anger, of exaggerated shame, of excessive pain, or of fear, has caused sudden death by producing syncope, the heart's action being interrupted by energetic and persistent excitation of the inhibitory nerves of the heart. Sudden death has followed the entrance of air into the uterine sinuses; a fatal case has been recorded from embolus of fat from the pelvic connective tissue, and death in the puerperium has followed rupture of a gastric ulcer and of a liver-abscess. The most frequent causes of sudden death in the puerperium, arranged in the order of their relative frequency, are embolism, entrance of air into the uterine veins, and heart failure, due usually to organic disease.

Embolism and Thrombosis of the Pulmonary Artery.—Some authors—notably Playfair and Barker—insist that primary and spontaneous coagulation of the blood in the pulmonary artery occurs, and they attribute this accident in the puerperium to the excess of fibrin and water in the blood, to hemorrhage, to syncope and the diminished force of the blood-current, and to the quality of the blood changed by effete materials, by sepsis, or by blood-dyscrasia. On the contrary, other writers favor the notion that embolism usually, if not always, precedes the occurrence of thrombosis, and they support this belief by the uncertainty of the pathologist's knowledge of a primary thrombosis in the right side of the heart and in the pulmonary artery, and by the facts that in about half of the cases a peripheral thrombus has been demonstrated; that the accident commonly occurs after dislodgement of a peripheral thrombus in either a femoral, an iliac, or a uterine vein following a sudden effort, such as assuming an upright posture, laughing, straining at stool, the administration of a vaginal or an intra-uterine douche, etc., any of which efforts do not cause thrombosis, but may loosen a thrombus; and, finally, that thrombosis of the pulmonary artery should occur more frequently, since the asserted predisposing causes are so commonly observed in the puerperium. It is certainly true that in many recorded autopsies, when thrombosis has been found in the pulmonary artery a scrutinizing search for a peripheral thrombus has not been mentioned. Whenever an autopsy is made, as should always be done upon a woman dying suddenly in the puerperium with symptoms of pulmonary obstruction, a most careful search for a peripheral thrombus should never be neglected.

Prognosis and Diagnosis.—When a large-sized thrombus obstructs the pulmonary artery, death may be instantaneous, or it may be preceded by precordial oppression, great fear of impending death, extreme dyspnea, cyanosis, and a rapid loss of body-heat. The heart's action is violent; the pulse is small, rapid, and irregular. Sometimes a murmur is heard over the orifice of the pulmonary artery, and in one case the patient was able to breathe better lying prone; in another case respiration was easier in the supine posture. In other cases, if the embolus is small the onset of symptoms is not so sudden, and the symptoms are similar but not so severe, in which cases death may occur after several days, or very rarely recovery may follow. From a study of twenty-five cases Playfair concluded that when the accident occurs before the nineteenth day of the puerperium the obstruction of the pulmonary artery is most likely due to a primary thrombosis; after the nineteenth day, to embolism.

Treatment.—Little can be done for an accident so grave as obstruction of the pulmonary artery. The patient should be kept absolutely at rest, and stimulants, including the carbonate of ammonium, should be administered. Prophylaxis is of far greater value. Early exertion on the part of the puerperal patient must always be avoided, especially during and after intra-uterine manipulations, and especially when phlegmasia exists; and massage for the latter disease, as frequently advised during the stage of convalescence, must be undertaken with the greatest caution.

Entrance of Air into the Uterine Sinuses.—Although experiments upon animals have shown that the direct injection of large quantities of air into the circulation is not fatal (Hare), the clinical evidence of deaths from this cause in obstetrical and surgical practice is incontestable. Lauffs¹⁴¹ collected 43 cases of death following air-embolism in the uterine veins. In seventeen cases the entrance of the air was caused by injections into the birth-canal; in eighteen the entrance of air into the uterus was spontaneous; in eight gas was formed in the uterus. Post-mortem examinations proved the presence of air in thirty-one of the 39 fatal cases. In the reported cases of sudden death from a large quantity of air entering the veins of the uterus death occurred immediately or within twenty-four hours after delivery.

Etiology.—From experiments and from observation of cases it is believed that air very rarely enters spontaneously into the veins of the uterus, and that to cause speedy death the quantity of air must be considerable and the air must enter the circulation with force, as may happen during uterine contraction when the air has entered and the cervix is obstructed by the placenta or by a clot. The entrance of air into the uterus is effected during intra-uterine manipulations, such as the introduction of the hand; the giving of an intra-uterine douche; by aspiration following a change in the posture of the patient. It has been asserted that air may be aspirated into the uterus by the movements of ordinary respiration (Amussat), or that its presence in the uterus may be due to decomposition (Churchill) or to alternate contractions and relaxations of the uterus following delivery (Simpson). Winckel¹⁴² mentions a case of air-embolism and sudden death due to carcinoma complicating labor.

Symptoms.—There may be difficulty in breathing and a temporary loss of consciousness when the quantity of air entering the veins is small; when a large amount rapidly enters the veins, respiration and circulation are immediately and desperately embarrassed; the patient may utter a cry of alarm, and at once becomes unconscious with or without convulsions. The cause of death is probably mechanical interference with the circulation.

Treatment.—Very little can be done for the patient even when assistance is close at hand. The cervix should be cleared of clots; artificial respiration and the hypodermatic administration of stimulants should promptly be employed. Tracheotomy and the inhalation of oxygen gas in order to inflate the lungs and to expel the air-emboli have been suggested.

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V. THE NEW-BORN INFANT.

I. PHYSIOLOGY OF THE NEW-BORN INFANT.

THE physiology of the new-born infant differs in many essential respects from that of the adult. A better understanding of these differences than we now possess would no doubt aid us greatly in the proper interpretation of the signs of approaching and of existing disease, as well as in the management and treatment of the disorders of infancy. In the present article only those physiological differences between the new-born and the adult will be considered that are of special importance.

Growth: Weight.—The new-born child weighs, upon the average, seven pounds (3483 grams), boys weighing, as a rule, about half a pound more than girls. A considerably less weight than this is frequently observed in perfectly sound, well-developed babies, particularly in the case of twins, while ten- and twelve-pound babies are not uncommon. Those weighing over twelve pounds are occasionally seen, and if published records are to be trusted children have been born weighing as much as twenty-four pounds. It has been shown that the weight of the child is greatly influenced by—1, the length of gestation and the nourishment of the fetus; 2, the age of the mother (very young mothers giving birth, as a rule, to small babies); 3, the size of the mother (the weight of the child being 5.23 per cent. of that of the mother); 4, the number of previous pregnancies (the weight often progressively increasing up to the fourth or fifth pregnancy); and 5, the influence of race and climate. For two or three days after birth there is usually a loss in weight of from three to six ounces, which loss is probably due to an absence of nutritive material from the maternal mammary secretion during this time, as well as to the increased tissue-change consequent upon the circulatory changes and upon the establishment of respiration. The loss is greater in small than in large children, and they do not so quickly recover. After the establishment of the flow of milk the child begins to gain, and usually by the end of the first week it weighs about as much as it did at birth. The gain is somewhat slower in those babies fed on artificial food or even upon cow's milk. The increase after the first week varies considerably, and it is dependent upon a number of conditions, such as sex, race, nutrition, etc. The increase may be very irregular, an interval in which there may be neither loss nor gain following or preceding a quite rapid increase in weight. Approximately, however, it has been computed that an average-sized healthy child will gain about .78 ounces daily for the first three months, .63 ounces daily for the second three months, .45 ounces daily for the third three months, and .30 ounces daily for the fourth three months. The total weight would therefore be, at the end

of three months, ten pounds ; at the end of six months, from thirteen to fourteen pounds ; at nine months, from sixteen to seventeen pounds ; and at twelve months from nineteen to twenty pounds, the increase in weight being doubled in the first six months and trebled in the second six months.

Length.—At birth the average healthy child measures between nineteen and twenty inches (50 cm.) in length, the male being slightly longer than the female. By the end of the first month the child will show a length of $22\frac{1}{2}$ inches ; at the third month, $25\frac{1}{2}$ inches ; at the sixth month, $28\frac{1}{2}$ inches ; at the tenth month, $31\frac{1}{2}$ inches ; at the fifteenth month, $34\frac{1}{2}$ inches, etc., thus showing an increase in length of 3 inches during these periods. During the first year there is generally a gain in length of from 6 to 10 inches. There may at times be a rapid increase in weight with no increase in length, and at other times an increase in length with no corresponding gain in weight. In making accurate observations the growth in weight and in length should be compared and due allowance be made for the passage of feces and urine.

Size and Growth of the Head, Thorax, etc.—The occipito-frontal circumference of the head of an average-sized new-born infant is about $13\frac{3}{4}$ inches for males and $13\frac{1}{4}$ inches for females (34.5 cm.). At the end of twenty-one months the circumference has increased to about $19\frac{3}{4}$ inches. The anterior fontanelle continues to increase in size until the ninth month ; then it gradually closes, finally becoming completely closed in, ossification taking place from the borders in from sixteen to eighteen months.

The average circumference of the chest at birth is about $12\frac{1}{4}$ inches ; this increases to $16\frac{1}{4}$ inches in twenty-one months. The rate of chest-growth is more rapid than that of the head. The body is proportionately wider in the infant than in the adult. The antero-posterior measurements of the head and the pelvis are the same at birth in males and females.

Respiration.—In response to stimulation of the respiratory centres the child immediately after birth, sometimes before and sometimes after the cessation of pulsation in the cord, makes its first inspiratory effort. After one or more such efforts many of the collapsed vesicles are distended and filled with air. Generally the complete unfolding of the alveoli does not take place until the second day. This first inspiration is followed immediately by expiration, and the mechanism of pulmonary respiration is established. The new-born child breathes about forty times a minute. Its respirations are, however, irregular, and they may be influenced considerably by slight causes ; for instance, there may be a suspension for comparatively long intervals by attention, by muscular effort of various kinds, by fright, etc. Respiration is most regular during sleep, and this is the only time in which it may accurately be observed. A much larger percentage of the respired air is exchanged in infancy than in adult life, the amount being one-fourth in the former to one-tenth in the latter. The exchange is generally feeble at first, being a third more at the end of the first week than on the first day. In respiration the thorax is elevated progressively from above downward, the work being done largely by the diaphragm.

Circulatory System.—With the first inspiration of the new-born child there is a complete alteration of the circulation of the blood. The pulmonary arteries, until now containing only sufficient blood to supply the pulmonary nutrient vessels, become fully distended with blood to be carried to the lungs for aëration. The flow of blood being diverted from the ductus arteriosus to the pulmonary arteries, largely by the enlargement of the thorax in the first act of inspiration, the duct partially collapses, thrombi form within it, and it rapidly becomes obliterated. When the umbilical cord is tied or the circulation through it ceases spontaneously, the umbilical arteries and vein and the ductus venosus become at once greatly reduced in size, fill with thrombi, and finally become converted into fibrous cords. The foramen ovale is more gradually closed, the edge of the Eustachian valve remaining free for some time, but at the same time affording complete protection to the foramen.

Owing to the more rapid growth of the upper part of the body and to the proportionately large amount of work thrown upon the lungs, the carotid, subclavian, and pulmonary arteries are comparatively large. At the same time the heart is small, so that the systemic blood-pressure in the new-born is low. The pulmonary artery is much wider than the aorta in infancy—more so than in later life—so that the pulmonary blood-pressure is greater in the infant's than in the adult's lungs. The size of the heart is to the width of the ascending aorta as 25:20 in the new-born; in the adult, 290:61. The systemic blood-pressure is raised as the heart increases in size and the aorta becomes relatively smaller.

The blood of the new-born is comparatively less in amount than that in the adult, but after a few months the proportion of blood to body-weight is more than in the adult, but with a low specific gravity (1045–1049). At birth the amount of hemoglobin is large (22 per cent.), but the amount of fibrin is small. The hemoglobin begins at once to diminish in amount, reaching its minimum at the sixth month. The fibrin rapidly increases in amount. The infant's blood contains more white corpuscles than does that of the adult, less salts, and less soluble albumin.

The pulse for a few weeks after birth is very feeble and rapid, and it is easily disturbed and accelerated by slight causes. During sleep in the first week it averages about 120 beats to the minute; while awake, 126; and under excitement, 148 to 150. Later the number of pulsations diminish during sleep, while the number under excitement increase. Posture has but little effect upon the frequency of the pulse.

Digestive System.—Saliva is secreted immediately after birth, but in very small quantities and of weak diastatic action. The salivary glands are poorly developed, and for a few weeks at least the saliva is furnished almost wholly by the parotid gland. After two months the amount secreted is considerably increased, and it shows much greater diastatic power. At eleven months the diastatic power of the salivary secretion is nearly equal to that of the adult.

The stomach is relatively smaller, more cylindrical, and more vertically

situated than in the adult, and its muscular structure is poorly developed. At birth the capacity of the stomach is about one ounce, and there is an increase of one ounce per month up to the sixth month, after which the increase is not so rapid. The healthy stomach contains saliva, mucus, hematin, and blood-corpuscles. During the first two months of life the normal acid for the stomach is hydrochloric acid. The quantity of food in the stomach diminishes rapidly during the first hour, and in from two to two and a half hours the balance entirely disappears. The contents of the stomach are not so decidedly acid as in that of adults. Albumin is seldom found in the stomach, and only during the first hour of digestion. Water assists in the digestion of casein.

The *pancreas* remains in an undeveloped condition for five or six months after birth, and the action, therefore, of its secretion is very feeble indeed. The *liver* is of very large relative size at birth, occupying more than half of the entire abdominal cavity. *Bile*, light brown in color, is secreted early, and gives to the feces their orange-yellow color.

The *small intestine* is comparatively long, being at birth about 9 feet 5 inches in length, and it grows at the rate of 2 feet per month for two months. The intestinal villi are numerous, are as large as those in adults, and are supplied with very large capillaries, through which absorption is quite rapid. The glands of Lieberkühn and Peyer's glands are few in number and are poorly developed. There is a very copious secretion of mucus, which readily undergoes acid fermentation, especially in the presence of particles of undigested food, the feebly alkaline secretions of the liver, pancreas, and intestines being easily neutralized.

The *large intestine* is also of relatively great length, measuring 1 foot 10 inches at birth. The ascending and transverse colons are short compared with the descending colon, especially the sigmoid flexure. This structure is bent upon itself from one to three times, and it is the cause of congenital constipation. Later readjustment takes place, the ascending and transverse portions increasing in length at the expense of the descending colon.

The *feces* of the new-born consist, during the first two or three days, of *meconium*. The meconium, which has been accumulating in the intestines during fetal life, is a thick, tarry, greenish-black substance resembling thick poppy-juice. It consists of bile and mucus, together with epithelial cells, fine hairs, and fat-globules from swallowed amniotic fluid. On the third or the fourth day the feces consist of a mixture of meconium and digested milk. After the fourth day the feces are light orange-yellow in color and they consist of the residue of digested milk. They are passed from two to four times a day.

Urinary System.—At birth the kidneys are lobulated, fully developed, and functionally active, the secretion of urine taking place before birth. A gradual change takes place in the form of the kidney, so that in about two years it loses its lobulated form and resembles the adult kidney, being relatively somewhat larger.

The Skin.—Owing to more or less obstruction of the fetal circulation

during delivery the child's skin is at first of a livid hue. Upon the establishment of respiration this hue is changed to a deep red, due to the irritant action of the air. In a few days the color is changed from red to a yellowish or icteric tint, which is said to be caused by the deposit of blood-pigment during the preceding congested condition of the skin. The yellowish color gradually fades, the skin becomes paler, and finally, within three weeks, the normal rosy tint is established. More or less desquamation takes place during this time as a result of the early congestion.

The sudoriparous glands, on the one hand, are almost if not quite inactive at birth; the *sebaceous glands*, on the other hand, are very active during fetal life and up to the end of the first year. The body of the infant at birth is covered with the vernix caseosa, which is composed of the secretion from the sebaceous glands. The hair of the scalp is strong and from 1 to 2 inches long; it falls out later, and is replaced by hair finer in texture and generally lighter in color. The short, fine, downy hair with which the whole body is covered at birth drops out in about three weeks, and is not replaced.

Lymphatic System.—The lymphatic system is relatively better developed and more active, and the glands larger and more numerous, at birth than in adult life. The relation between the lymphatics and the other tissues and organs of the body is very close, and absorption is very rapid.

The temperature falls directly after birth, but by the end of the second day it rises to the maximum again (97.5° to 98° F.), where it remains stationary.

Fat is generally absent from the interior of the body, but it is abundantly present in the subcutaneous tissues.

The muscles at birth are small and soft, but they become better developed, firmer, and more resisting by the sixth month. They contain more water and less myosin than do the muscles of adults, and more extractive matters, fats, and inorganic constituents.

The bones are less brittle than later in life, containing a large percentage of organic matter.

The Nervous System.—The rate and degree of development of the nervous system and of its various functions are largely influenced by heredity, environment, and by the health of the child. The faculties and senses are more or less dependent upon each other for their perfect development, as is so clearly shown in the slow, tardy, and incomplete development of the mental faculties when hearing is absent or defective, and in the non-appearance of articulate speech when the sense of hearing is absent.

Not until the first month after birth does the gray matter appear on the brain convolutions; before this the cerebrum is soft and of a uniform color. The medulla and cord-centres are much better developed at birth than those of the brain, and they remain more active throughout infancy. The motor centres in the anterior cornua are more highly developed than are the sensory centres in the posterior portions of the cord. The extreme reflex excitability in the new-born is thus a physiological process.

Special Senses.—The special senses all respond to stimuli at birth or shortly after, but to a limited extent, and to bring out these reflexes to any marked degree the stimuli must be more intense or must be applied over a larger area than is required later.

The sense of smell responds to strong stimuli very soon after birth, and the ability to distinguish between agreeable and disagreeable odors is acquired early.

Taste exists even at an earlier period than does smell, and the response to sweet and bitter substances is different immediately after birth, the child being soon able to judge between the different forms of food offered.

Hearing is very imperfect at first, and at least several hours elapse before even very loud or sharp noises are capable of exciting responsive movements. The horizontal position of the tympanum, the as yet closed Eustachian tube, and the absence of air in the middle ear are offered as reasons for the imperfection of this sense. In two or three months the infant is able to determine from which direction a sound comes. The proper development of the mental faculties depends more upon the sense of hearing than upon any of the other special senses.

Sight is only developed at birth to the extent of a feeble response to very strong lights. Up to the sixth week there is inability at co-ordination of the ocular muscles. After this time the eyes begin to move in an orderly manner, and they will follow a bright object moved slowly in front of them. At about the second month rapid movements are perceived, as is evidenced by the child closing its eyes quickly on an object suddenly approaching it. At three months the development of sight goes on more rapidly and the child begins to separate colors. The first colors recognized are yellow, red, pure white, gray, and black. The recognition of green and blue comes later. The faculty of distinguishing between the various colors, however, is not perfected until after the third year. The estimation of size and distance is gradually developed after the sixth month. The mother is recognized about the third month.

The sense of feeling or touch reacts very feebly to stimuli, owing to the imperfect development of the brain and the skin, unless applied over a relatively large area. Pleasurable sensations existing during the first three months are those created by the taking of food when hungry, the act of sucking, the sweet taste of the milk, and the staying of danger, each being in itself a pleasurable sensation. A little later the healthy babe who is not hungry enjoys the warm bath, the stimulation of attention by bright objects, and in having its limbs unconfined by clothing. The developing ability for grasping after three months gives the infant additional pleasure.

Muscular action in the new-born is entirely involuntary, there being no voluntary act until about the end of the third month. Sucking and licking are not dependent entirely upon reflex action, but are largely instinctive. The stretching and bending of the extremities are impulsive acts, and occur during sleep, as they did during intra-uterine life. Straightening of the legs

after awaking is noticed during the second week. Vocal sounds are also impulsive. Reflex movements are not so strongly marked at birth as they are a little later on. These involuntary movements are purposeless and show lack of co-ordination. The act of raising the head, which is attempted toward the fourth month in healthy children, is volitional, requiring not so much added strength of muscle as power of co-ordination. As volition develops the power of co-ordination gradually increases, and the child learns to perform voluntary or purposeful acts. Voluntary grasping is done after the fourth month. As the child learns to balance its head it attempts to sit up. This act is not successfully accomplished until about the fortieth week; the child sits firmly alone when ten or eleven months old. Those children that creep do so at about the ninth month. Standing, which is attempted at about the ninth month, is usually successful at the end of the first year or a little earlier. Some children walk as early as the eighth month, many by the twelfth month, while some do not walk until much later. Most children will walk alone by the sixteenth month.

Speech is very gradually developed, distinct words not being uttered much before the end of the first year, often considerably later. The use of vowels and of inarticulate sounds, together with gestures, answer the child's purpose of making its wishes known. As the will develops and the power of mimicry is established vocal sounds and gestures become more and more intelligible, and finally articulate words are added. Single words are used for some time to express several ideas, then two words are put together, and finally short sentences are formed.

II. PATHOLOGY OF THE NEW-BORN INFANT.

1. MEDICAL AND SURGICAL DISEASES INCIDENT TO THE BIRTH OF THE CHILD.

ASPHYXIA OF THE NEW-BORN.—The respiration of a child immediately after birth is usually somewhat irregular, but it soon becomes rhythmic, and within a short time inspiration and expiration take place in a normal manner. Any deviations from this, as indicated by slight difficulty in breathing on account of a large amount of mucus in the trachea or the bronchial tubes, to absolute apnea, in which there is no attempt on the part of the child to respire, represent the different grades of what is called "asphyxia of the new-born."

The phenomenon described is entirely due to imperfect aëration of the blood. It is because there has not been proper interchange of oxygen and carbonic acid gas in the blood of the new-born—a condition which may arise from causes that have been operating for some time in the uterus or on account of some delay or unavoidable process in the birth of the child. It is hardly necessary to speak of the physiology of the circulation in the placenta, that wonderful and perfect arrangement by which oxygen is received by the fetus and carbonic acid is thrown off by the mother.

The general subject of asphyxia of the new-born may be divided into two subdivisions: first, *intra-uterine asphyxia*; second, *extra-uterine asphyxia*, or that form which presents itself immediately or a short time after birth.

Three divisions or three different grades of asphyxia of the new-born will be made, and they will be named in the order of their severity: *First*, slight difficulty in breathing from the collection of mucus or any foreign substance in any part of the respiratory apparatus; *secondly*, an asphyxia which is present in the child, who when born is strong and robust and full-blooded; *thirdly*, a child born asphyxiated, pale, limp, and apparently lifeless. The second and third classifications have by some of the older authors been spoken of respectively as "sthenic" and "asthenic," or the apoplectic and anemic varieties. The first class is quite insignificant, and usually respiration is established without any treatment whatever. The exposure to the irritation of the atmosphere or occasionally a smart slap on the buttocks is all that is needed in the simple variety. The other two classes, which are exceedingly important, and many times very dangerous, will now be considered in their proper order.

Intra-uterine Asphyxia.—*Etiology.*—The causes of the intra-uterine form of asphyxia arise from two sources—those originating from the mother and those originating from the fetus. The causes present in the mother that may produce this dangerous difficulty in her child are mainly disturbances of placental circulation, either from peculiarity of pain or from diseases which lead to a small supply of oxygen to her child. The causes which originate in the fetus are interferences with the cord and the placenta, pressure upon the head, and a natural or an acquired feebleness which may be produced because the parents are either immature or aged, or because the delivery is premature.

The pathological changes in intra-uterine asphyxia are about the same as those that follow when suffocation takes place from other causes. The blood is thin, the sinuses of the brain are filled with blood, with some edema of the membranes, and extravasations and slight ecchymoses are found in different parts of the several organs. The lungs are dark in color, are somewhat more firm than usual, and appear to be filled with blood. The air-passages are quite uniformly filled with mucus, meconium, and amniotic fluid. This condition suggests the question which is frequently asked as to whether the child inspires *in utero*. In some obstetrical operations, or when the hand is introduced into the uterus to perform version, air enters the cavity and produces its reflex irritation, and the child makes an effort to inspire, and in this manner draws meconium and amniotic fluid into its respiratory passages.

Symptoms of the intra-uterine form of asphyxia, of course, are difficult to be observed, and they can be determined only by very close observation of the child *in utero*. A very slow or a very rapid pulse, a symptom to which we attach the greatest importance, intimates either pneumogastric irritation or paralysis. Then follows increased intestinal peristalsis, and finally muscular spasm, to which, it appears to the writer, should be added unusual movements of the child. In all prolonged labors and before prolonged obstetrical operations it is always well to examine carefully the heart-beat of the child,

because in cases of asphyxia it is important to know whether any symptoms existed previous to the birth of a child, or whether the condition obtained is the result of its passage through the parturient canal.

Diagnosis.—It will be from such examinations as above suggested that we shall be able to anticipate danger to the child, so that in all tedious and particularly difficult labors these observations should be instituted. If the heart-beat is either unusually slow or fast, we should conclude that there is commencing danger to the child. The appearance of meconium, it seems to the writer, has been over-estimated, as in a number of cases he has seen this discharge before the delivery of the child, and yet there has been born a perfectly healthy and non-asphyxiated child. In breech labors it is certainly not to be regarded as a sign of threatened asphyxia. Any unusual hemorrhage before birth, indicating partial detachment of the placenta, is a very significant symptom and deserves earnest attention.

Prognosis.—The prognosis will also depend upon the condition of the child and the possibilities of an easy and rapid delivery.

Treatment.—In threatened asphyxia of the child the indication is to deliver with all possible rapidity consistent with the safety of the mother.

Extra-uterine Asphyxia.—*Etiology.*—In a vast majority of cases of extra-uterine asphyxia there is no interference with the placental circulation; the watchfulness with which the child *in utero* has been observed has revealed nothing, yet upon the birth of the child breathing does not take place. Asphyxia has developed from causes operative while the child is passing through the parturient canal or from diseases which interfere with the original process of respiration. These causes are malformations of the respiratory or circulatory organs, intra-uterine disease of the fetus, or premature birth. Among the diseases which operate more frequently in the production of extra-uterine asphyxia may be mentioned particularly the diseases of the lungs, such as atelectasis, pneumonia, syphilitic diseases of the lungs, large pleural exudates, compression of the air-passages by large glands, and injuries to the respiratory centres from difficult labors.

Pathology.—External marks and conditions that have operated to produce asphyxia will readily be seen. The head also shows signs of compression and perhaps unnatural moulding. The lungs are frequently not fully expanded; indeed, in some instances large areas are found in the condition known as *atelectasis*.

Symptoms.—When a child is born naturally it begins to breathe, and usually to cry quite lustily. It opens its eyes, makes a face as if disgusted with the surroundings, moves its extremities, and the integument assumes a rosy hue. A child born asphyxiated presents one of two conditions altogether different from those above described. The child is either large and robust, the skin is of a livid color, and without doubt it is a strong child (sthenic), or it is pale, wan, and anemic (asthenic). There is but little if any attempt at respiration. To all intents and purposes the child is dead. In many cases there is no heart-beat perceptible. In the first grade the child is deeply cya-

nosed; the cord is pulsating violently; the reflexes are not wholly abolished. In the second, an advanced stage of asphyxia, the pulsation may not be distinguishable; the surface of the body is extremely pallid; the extremities are motionless; reflexes and muscular tone are absent.

Diagnosis.—It is of great importance to know whether the asphyxia took place from causes intra-uterine or later, and it is also important to know which of the two forms of asphyxia, the mild or the grave, is present in each individual case. If very great pressure has been made upon the head of the child, either because the labor has been long and tedious or because instruments have been used for a long time, or if a visible hemorrhage is present, the asphyxia is in all probability due to causes operating during the passage through the parturient canal. Observations which have been made during labor, then, are very important in determining the probable cause of asphyxia. If, however, we know that there has been partial separation of the placenta before birth, and if we find the air-passages of the child filled with inspired foreign material, the asphyxiated condition of the child is in all probability due to intra-uterine causes.

Prognosis.—In the first form—that is, where the child is strong and the muscular tone and nervous irritability are not lost—if there are no other complications, the prognosis is generally good. In the second form it is always doubtful. If pressure on the head has been long and severe, and hemorrhage takes place at the base of the brain, the prognosis is bad. If the hemorrhage takes place on the convexity of the brain, the child may live longer, but the mental condition is usually bad.

How to Determine the Grade of Asphyxia.—The grade of asphyxia can be determined by irritation of the palate. If upon the introduction of the finger to remove the mucus there are choking and convulsive movements, and consequently attempts to breathe, and the presence of the reflexes is shown, it is asphyxia of the first grade, and the prognosis is good. If this irritation of the palate produces no action, but the palate remains soft, then the asphyxia is of the second grade, and the prognosis is bad.

Treatment.—In every case of labor where it is known to be serious or tedious, preparations for the reception of an asphyxiated child should be made before its birth. A table should be placed in the lying-in chamber, and upon it a pillow and a waterproof sheet should be in readiness; hot and cold water in proper receptacles should be at hand, and also a soft catheter or some other appliance for the withdrawal of mucus and other substances from the respiratory passages; an electric battery may be of use.

Treatment of the First Grade of Asphyxia.—The chief indications in the treatment of the first grade of asphyxia are—remove all obstruction from the air-passages, and by the application of reflex stimuli excite respiratory efforts. Remove mucus from the throat and mouth of the child; irritate the skin by slapping the buttocks and rubbing; pass before the respiratory organs some of the diffusive stimulants, such as camphor or preparations of ammonia. To remove foreign material from the trachea and the bronchial tubes grasp the

child by its feet, the head hanging downward; pass the little finger into the throat and wipe out the mucus. Care should be taken not to produce traumatism in the post-pharyngeal space, and so open an entrance for infection. Further to remove the mucus from the trachea, press upon the trachea with the finger as low down as the bifurcation, and gently squeeze the trachea toward the larynx. This forces the mucus into the back part of the pharynx or post-nasal space, and it can now be forced through the nose of the child by blowing into its mouth; the obstetrician should protect his mouth with a hand-

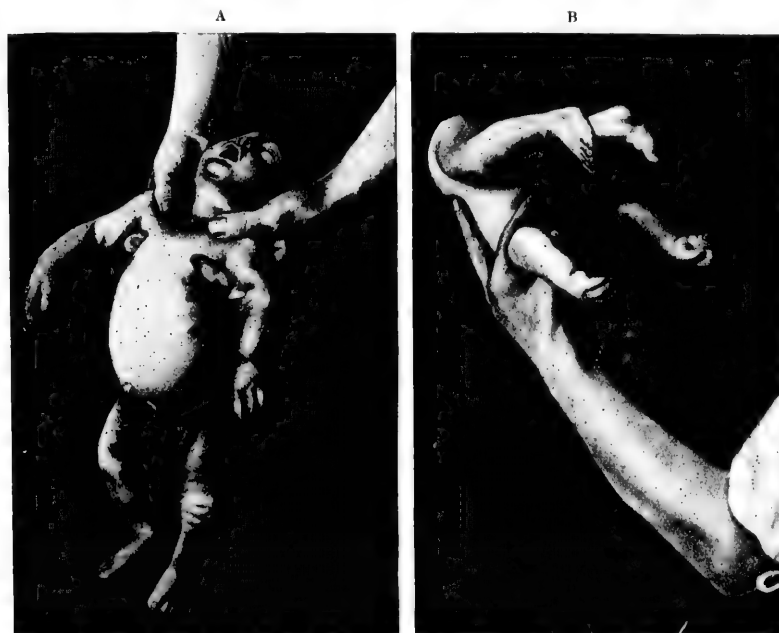


FIG. 441.—Schultze's method of artificial respiration: A, inspiration; B, expiration.

kerchief. If now the child does not begin to breathe, give it a warm bath or possibly alternate between a warm and a cool bath. Repeat all these measures, and watch the child carefully until respiration is fully and perfectly established.

Treatment of the Second Grade of Asphyxia.—If it is found by irritation of the throat that the reflexes are absent and that the child is in this severe and dangerous form of asphyxia, our treatment must be more heroic from the first. Of course the air-passages should be cleared of mucus. It is useless, however, with a child in this grade of asphyxia to attempt to make it breathe by irritation of the skin, and, while many of the procedures suggested in the first grade may be used, artificial respiration, by means of which air may be forced into the chest, must very soon be resorted to; while the method of Marshall Hall or of Sylvester may be used, the proceeding as laid down by Schultze,

and briefly described below, has, the writer believes, been followed by the best results (Fig. 441).

The physician seizes the child's shoulders by putting an index finger in the axillary space and his thumbs so curved forward and over the shoulders as to strike the end of the finger, so that the entire weight of the child's body is resting upon or within the circles made by the thumb and the first finger of each hand. While the child's body is hanging perpendicularly the ribs are being lifted out, the chest is expanded, and mechanical inspiration is produced. To produce, now, a mechanical expiration, the body of the child is swung forward with some little force at arm's length until the operator's arms are a little above a horizontal line. A somewhat abrupt termination of this motion causes the thorax of the child to become stationary, while the lower limbs topple over upward and forward upon the child's abdomen. The abdominal viscera, in the position in which the chest is at this moment, press against the diaphragm and produce expiration. The child's body is now returned to its original position by nearly reverse motions; the entire manœuvre occupies from seven to eight seconds and is repeated eight or ten times each minute. After practising this method for two or three minutes it is desirable to place the child in a warm bath to restore the body-heat lost during the swinging movements.

Mouth-to-mouth insufflation is also a valuable method to secure the entrance of air into the child's lungs. A towel is placed over the child's mouth, and the operator, after taking a deep inspiration, quickly but gently blows into the mouth of the child, and then gently compresses its chest. In this manner the child's lungs should alternately be inflated and emptied ten or fifteen times a minute. To prevent injury to the air-vesicles the lungs should be inflated gently, and the nasal passages should not, as sometimes advised, be closed by pressure with the fingers. Sometimes insufflation through a catheter passed into the larynx is of service.

In the severe form of asphyxia and in prematurely born children most remarkable results are sometimes obtained by keeping these children in some kind of a warming apparatus or incubator (see Figs. 444-448, p. 863).

Caput Succedaneum.—In quite a number of cases there are seen immediately or very soon after birth enlargements, contusions, or ecchymoses on the head or the presenting part of the child. It is not difficult to understand why or how these affections are produced, but one does have some trouble in determining whether they should be arranged under medical or under surgical affections. It is quite possible, then, that the present arrangement may not be absolutely correct, but this, it appears to the writer, is not particularly important if the main facts are presented, inasmuch as a description of these diseases or affections will be quite as instructive whether they are or are not arranged under their proper headings.

One of the most frequent enlargements noticed is named *caput succedaneum*. This phenomenon, which is rather constant, consists of a swelling, of varying shape and size, noticed upon the presenting part, especially the head. The swelling is produced usually by pressure of the dilating os uteri, but the same

kind of a swelling has been noticed upon the breech or the shoulder. The phenomena produced vary somewhat with the differences of position and extent and severity of the pressure.

Etiology.—The cause, as remarked above, has always been ascribed to pressure upon the unyielding os uteri, causing an infiltration of bloody serum in the tissues of the scalp below the constricting ring of the cervix; but inasmuch as this enlargement and the blood-tumor which will presently be described have been found on other than the presenting part, we must at this time confess that the cause is not always clear. It is possible that difficult labors with prolonged pressure by different parts of the uterus may be an etiological factor.

The pathology consists of a localized edematous condition of the soft parts of the scalp and the connective tissue with some extravasations of blood.

Diagnosis.—The diagnosis is not always easy, for there are found upon the head of a child several other enlargements from which the swelling must be differentiated. Chief among these enlargements are cephalhematoma, herniæ cerebri, vascular tumors, meningocele, encephalocele, and hydrencephalocele. A full description of cephalhematoma is given below, and herniæ of the brain and vascular tumors are treated on page 304. A brief description of the remaining three is as follows: *Meningocele* is a tumor of the scalp into which the meninges protrude; an *encephalocele* contains in addition to the meninges a small amount of brain-substance; and a *hydrencephalocele* contains a small amount of liquid in addition to brain-substance and the membrane.

Prognosis.—In caput succedaneum the prognosis is always good. If left alone, it almost entirely disappears within a short time.

Treatment.—Caput succedaneum will in every instance disappear without interference. In a case, however, where there is very extensive ecchymosis, which makes this the vulnerable point of the baby's body, care should be taken against infection. In this case an antiseptic dressing should be used as a protection.

Cephalhematoma.—Cephalhematoma is a soft, elastic, fluctuating tumor, generally painless and situated upon one of the cranial bones (Fig. 442). It is stated by some writers that the tumor occurs more frequently upon the right parietal bone, but of the six cases seen during the first twelve years of the writer's practice five were upon the left parietal bone. The tumors are usually single, although a few observers, among them the writer's eminent preceptor, the late

Prof. William H. Byford, noticed one upon each side of the head. Hofmohl observed 26 bilateral cases, each with fontanelle between as a deep depression. This variety of tumor, it seems to the writer, should be confined to those cases where the collection of blood is upon the outside of the cranial bone,



FIG. 442.—Cephalhematoma.

while those upon the inside between the brain and the dura mater should be spoken of as "intracranial" hemorrhage and should be considered under a different heading. There must at least be a very wide difference in the clinical history of an external and an internal cephalhematoma. The first is rather insignificant, while the second would in many cases prove fatal.

Frequency.—Cephalhematoma occurs with greater frequency than writers would lead us to suppose. When first writing upon this subject, at the end of twelve years' practice, the writer had seen six cases, and in the first 1000 labors which he attended twenty cases of cephalhematoma occurred. Henning had 230 out of 53,506 cases, or 0.43 per cent., and Hofmohl 371 in 59,885 cases, or 0.6 per cent. The percentage was about 2 in the writer's cases. The disease is said to be more frequent in males.

Etiology.—This difficulty has in almost all instances been ascribed to pressure upon the cranial surface by the cervix uteri. Without doubt a great majority of cases are caused by this pressure, but from the fact that cephalhematomata have been observed in breech births, it must be admitted that in every case the rigidity of the os uteri does not produce the tumor. It has appeared to the writer that, in addition to the pressure exerted either by an unyielding os or by forceps, there may exist a tendency on the part of the blood-vessels to rupture; there is an undue thinness, which makes this difficulty more likely to occur.

Symptoms.—This form of head tumor is not present usually at the birth of a child; indeed, from one to four days elapse before attention is called to this difficulty. When first noticed it is usually a soft, painless enlargement, situated upon a parietal bone, varying from the size of a hazelnut to that of an apple. It may so extend as to include the surface of the entire cranial bone, but it never crosses a suture or a fontanelle. There is no discoloration of the skin in cases observed by the writer, and neither the pulse nor the circulation of the child is accelerated to an extent that would denote any disease or complication. The greatest size of the tumor is usually reached at the end of a week; it then remains stationary for a few days, and then begins the subsidence and diminution by which nature perfects a cure. In a large number of cases in from four to ten weeks there is nothing to indicate that there has been a tumor or a growth of any character.

Diagnosis.—The diagnosis is a very important question, and one not easily made out by many physicians. Not many years ago the writer was called to see what was supposed to be a hernia cerebri, which proved to be a cephalhematoma. The principal affections with which a cephalhematoma may be confounded are caput succedaneum, hernia cerebri, erectile tumors or angiomas of the scalp, and the different forms of soft tumor that have been enumerated in the consideration of caput succedaneum, to which should be added, in the writer's judgment, the condition known as *craniotabes*. The means of differentiation may briefly be stated. Caput succedaneum is an edematous condition of the tissue of the scalp that is present at birth, and it disappears rapidly without any accompanying symptoms. It has a boggy feel, while in cephalhematoma there is always some fluid. The position, process of repair, and

duration are also quite different. It should be remarked here that caput succedaneum may hide a cephalhematoma for three or four days. From hernia cerebri the differentiation should not be difficult. The hernia occurs along the line of a suture or in the vicinity of a fontanelle; there is no fluctuation, but usually there is a pulsation which is synchronous with the heart-beat. Cries and agitation of the child cause a hernia cerebri to enlarge; not so with a cephalhematoma. A vascular tumor on the scalp has the same boggy feel noticed in caput succedaneum, but it never fluctuates, and usually there is a discoloration of the skin that is not present in a cephalhematoma.

By craniotabes is meant the soft places found upon the cranial bones in rickety children. It has appeared to the writer that a layer of bone in some rickety children can be so thin that a softness and fluctuation could almost be made out, thus giving rise to the suspicion that a blood-tumor of the scalp existed at that point. Such a case as this has never occurred in the writer's practice, but it always appeared possible, and in his teachings he has cautioned his students in this respect.

The enlargements on the scalp caused by protrusion of the meninges alone, or those containing fluid or brain-substance, will need no further consideration than that given on pages 304 and 818.

Complications.—When the hemorrhage is external complications are very rare. In a very few cases suppuration has taken place, or there has been such tension with pain as to interfere with the nutrition of the child. Of course, if pus is formed next to the brain, necrosis may take place or a meningitis might be effected. The danger is reduced almost to *nil* if maltreatment is not inaugurated by some surgical process. A cephalhematoma caused by forceps delivery may make a fracture obscure, and is a dangerous complication.

Process of Repair.—At the end of four or five days (it is stated by one author after a single day) where the swelling joins the cranial bone a very small, hard ridge will be felt. This ridge is the beginning of a hyperostosis, or a throwing out of bony material by which the bone and periosteum are

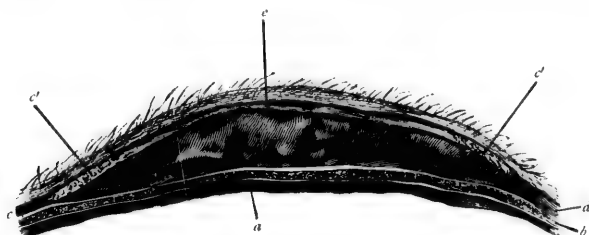


FIG. 443.—Longitudinal section through a cephalhematoma; a, dura mater; b, cranium; c, pericranium; c', beginning hyperostosis; e, scalp (Davis).

repaired, a resorption of blood having now begun to take place. There is not only a ridge of bony material, but there are also forming forward, toward the central part of the tumor, little projections, so that after a time a thin crust or shell of bone is absolutely formed over the swelling. This crust will some-

times crackle like parchment. During this time the blood and serum are being resorbed, and while this course of repair is slow, in all cases to which the writer's attention has been called a complete restoration has taken place without any induration or thickening. It has been stated that sometimes a hyperostosis remains at the seat of swelling, but this has not been true in the writer's cases.

Pathology.—A section through the blood-tumor (Fig. 443) reveals the fact that an extravasation of blood has taken place between the bone and the pericranium. The bone-surface is roughened, and the pericranium is attached only to the margin of the bone, where inflammatory irritation produces a perceptible thickening.

Prognosis.—If, as remarked above, a cephalhematoma is left alone, the prognosis, almost without exception, is excellent. If there is present a general systemic disease, the probability of resolution is not so good.

Treatment.—Interference, except in cases which will be mentioned, with the pretence that something is necessary deserves censure. Any deviation from this course, in the writer's judgment, is always fraught with danger. In regard to the advisability of surgical interference, there is in this operative era a difference of opinion. Winckel and Olshausen advise opening the tumor at about the sixth or eighth day, yet a case was lost by one of these gentlemen following this procedure. Among those who advise against operation are Hensch, Baginsky, Zweifel, Biedert, and especially the surgeon F. Koenig. The weight of authority is certainly against operative measures so long as there are no signs of inflammatory reaction or of suppuration.

Apoplexy of the New-born.—The *etiology* of cerebral hemorrhage of early life differs from that in the adult. While in the latter it usually results from a diseased condition of the arteries, rendering them liable to rupture, or from hypertrophy of the heart, in the infant it is often due to venous congestion, the hemorrhage occurring in the capillary vessels of the pia mater or in the choroid plexus. The pia mater in early infancy is very delicate. Apoplexy may also occur as a complication of cephalhematoma; it may be due to compression of the umbilical cord, producing asphyxia; it may be associated with atelectasis. There is usually a history of difficult labor, impaired circulation, perhaps convulsions, but it also occurs without the existence of other injuries where labor has been of long duration. C. Runge has found collections of blood the size of a pigeon's egg in the dura mater. These collections have been observed in normal labors.

Laceration of the sinuses may produce very extensive hemorrhage which will prove fatal. Interference with the circulation during labor, or pressure produced by the cord about the neck of the fetus, or the presence of struma, is sometimes followed by cerebral hemorrhage. These cases are usually asphyxiated. If respiration can be established, paralysis is likely to follow. Paralysis is not always marked at first, but may be noticed in the course of months; it may be followed by contractures. Speech is generally impaired, and intelligence is usually somewhat affected.

Congenital Atelectasis.—By atelectasis is meant a condition in which the

lung-tissue remains unexpanded, or, having been filled with air, collapses and returns to its condition before birth. Thus atelectasis may be either congenital or acquired. In the congenital variety the child evinces some difficulty in breathing at birth. Sometimes it is asphyxiated, and at other times the trouble is made manifest by rapid breathing and the want of expansion of one or both sides of the chest.

Etiology.—Atelectasis does not seem to be due to congenital difficulties with the respiratory apparatus, for in many cases the lungs can be expanded post-mortem without difficulty, nor is it due to an enlarged thymus gland. The majority of those who have investigated the cause of this difficulty believe that it is due to natural weakness of the infant or to some debilitated condition of the mother, premature birth, etc., rendering the respiratory muscles too feeble to elevate the thorax during respiration. Asphyxia and pressure on the brain from any cause, producing paralysis of the respiratory centre, is also considered a cause.

Frequency.—Congenital atelectasis is not frequent. The writer has seen but three or four cases of this condition—that is to say, where the condition lasted long enough to become very apparent.

Symptoms.—There is usually a cyanotic condition of the body of the child in congenital atelectasis; very soon the infant commences to cry, but respiration is exceedingly rapid and short. If a small portion of the lung is affected, the difficulty will be so temporary as hardly to be noticeable. If a considerable portion of the lung is congenitally collapsed, the difficulty in breathing will be more marked. Occasionally convulsions precede death.

Diagnosis.—The diagnosis, which is usually difficult, often not made during life, must be founded upon the rapid and irregular breathing, upon the cyanosis, and upon physical examination. The walls of the chest upon the affected side do not expand, and there is dulness on percussion.

Prognosis.—The prognosis depends on the extent and cause of the difficulty. If a large area is involved and the condition is accompanied by cerebral lesions, the prognosis will be unfavorable; if the area involved is small and unattended by cerebral lesions, the prognosis will be good.

Treatment.—The first object in treating congenital atelectasis must be to induce a deep inspiration. For this purpose an effort may be made to stimulate the respiratory muscles. Usually the only effective treatment is very gentle inflation of the lung through a soft catheter introduced into the larynx. Diffusible stimulants should be administered, the child must be surrounded by artificial heat, and everything must be done to support nutrition.

2. TRAUMATIC INJURIES OF THE NEW-BORN.

The principal factors in the production of injuries of the new-born are anomalies of the pelvis, deviations from the normal mechanism of labor, and the necessity for instrumental delivery; in addition, wounds of the presenting part are sometimes produced by the attendants either through ignorance or by rough handling.

A. Injuries to the Scalp, Face, Neck, Limbs, Trunk, and Bowels.--

Wounds of the *scalp and face* are frequently produced when artificial delivery is found necessary. Pressure by the blades of the forceps may produce lacerations of the scalp and forehead, contusions of the face, and injury to the facial plexus of nerves. These wounds are frequently bilateral, corresponding with the points where the forceps was applied, and where there is unusual resistance either from the parturient canal of the mother or from the bones of the skull of the child. Injuries to the presenting part are sometimes also produced even in normal labor. Thus the scalp has been injured in the attempt to rupture what was supposed to be the bag of waters. *Caput succedaneum* has likewise been thus mistaken and punctured, and even eyes and eyelids have thus been injured.

Injuries to the *head* are frequently indicative of pelvic deformities in the mother; especially is this true of the contracted pelvis. If the conjugate diameter is diminished, the promontory of the sacrum usually produces pressure on a limited spot or on two or three spots near each other. A spoon-shaped depression of the parietal bone may thus be produced. The neck of the fetus sometimes shows the effects of traction produced by long-continued extension. These effects are usually manifested by transverse striæ at the point where the strain of the integument was the greatest (Müller.) Sometimes subcutaneous lacerations occur, giving rise to more or less extensive extravasations of blood.

In the attempt to assist the after-coming head, especially if this is done by unskilful hands, a blood-tumor may form from a hemorrhage into the sheath of one of the sterno-cleido-mastoid muscles. This condition is known as *hematoma of the sterno-mastoid*. There is usually some laceration of the fibres of the muscles as well as injury to the vessels. This accident is more common in breech presentations, but it also occurs in head presentations, and has been observed after spontaneous delivery; in the latter case, however, the tumor is very small. The swelling is not always observed immediately after birth; it is generally irregular, somewhat elongated, situated usually in the upper part of the right sterno-cleido-mastoid, becoming harder, and disappearing in the course of from four to eight weeks. The *prognosis* is favorable as to the life of the child. Paralysis of the arm corresponding with the side on which the injury existed sometimes occurs, but this usually disappears with the tumor. This injury sometimes causes torticollis.

Fracture of the *clavicle*, in extracting the after-coming head, may result in puncture of the lung by the broken end of the bone.

In transverse presentations the upper extremities of the child are sometimes injured, the presenting arm being covered with excoriations, or the member may be considerably swollen. The large bowel may rupture from pre-existing ulceration, which is usually at the sigmoid flexure. Effusions of blood in the pleural and peritoneal cavities have been observed after difficult labor, and extraction of the feet or the breech is sometimes followed by injuries and lacerations of the abdominal viscera of the fetus.

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B. Injuries to the Skull and Other Bones.—The head of the new-born infant is commonly distorted by the pressure of the pelvic walls in normal labors, each presentation and position causing its characteristic change in the shape of the infant's head, the distortion disappearing a few hours after delivery. Injuries of the fetus affecting the bones of the head and extremities may occur from the pressure of instruments, from the hand of the obstetrician, and also spontaneously as a result of very rapid labor, especially if birth takes place while the mother is standing. Fractures and lacerations of the sutures are likely to result from a contracted pelvis.

Injuries to the cranial bones may be complete or incomplete fractures or simply depressions; any of them are frequently associated with cephalhematoma and intercranial hemorrhage. Cranial fractures when at all marked are usually accompanied by an extracranial or intracranial hematoma. Peripheral fractures may sometimes be extensive, and yet not be followed by serious consequences. Injuries of the occipital bone sometimes prove very serious, on account of compression of the occipital foramen. Occasionally injury to the medulla results.

Injuries to the spinal column sometimes result from traction on the child's feet or the breech in difficult labors. The injury consists usually in the separation of one or more of the epiphyses; the ligaments are usually unimpaired. Hemorrhages into the membranes may occur. Fractures of the clavicle and the humerus are likely to occur in breech presentations during the delivery of an arm. Separation of the epiphyses of the humerus may also occur, and it is liable to be mistaken for fracture of the neck of the scapula or for luxation of the humerus. This injury is always accompanied by an inward rotation of the humerus.

The treatment of these traumatic injuries, both of the soft parts and of the bones, will consist in observing the same rules as for corresponding injuries in older patients.

C. Injuries to the Brain and the Peripheral Nerves: Obstetrical Paralysis.—In some labors which have been terminated by the use of forceps, as well as some where manual interference is necessary, either from pressure by the forceps or by twisting or stretching or direct pressure of the hand, there is sometimes noticed slight paralysis either upon one side of the face or in one of the extremities. These lesions may be of peripheral or of central origin, the latter being usually the result of cerebral or of spinal hemorrhage. These hemorrhages have already been described (p. 822). Injuries to the nerves are usually an accompaniment of severe injuries of the bones, the fractured ends pressing upon the peripheral nerves or on some plexus. One form of paralysis is frequently produced in the attempt at delivering the arm: this form is known as Duchenne's obstetrical paralysis.

Sometimes there will be slight bruises or ecchymoses of the face, and, where manual interference has taken place, of the arms and legs. The first symptom noticed is generally the want of proper action of the muscles of the face. In some cases there will be retraction of the eyeball and contraction of

the pupil, a slight drooping of the eyelid, usually some irregularity of the mouth, and want of expression of the side of the face involved. Where the paralysis involves an arm or a limb (Duchenne's paralysis) the muscles will appear soft and flabby and the usual motions will be absent.

The diagnosis of obstetrical paralysis can be made without difficulty, as it is hardly possible that anything else could produce the symptoms in a new-born infant.

Prognosis.—Paralysis of the face, the result of injury, usually disappears in the course of a few weeks. Paralysis involving larger trunks of nerves, and in cases where the injury has been considerable, will be longer in disappearing, and in quite a percentage of these cases some permanent deformity will remain.

Treatment.—In paralysis of the face little more is necessary than to protect the parts which are bruised and ecchymosed by an antiseptic dressing, and after a time to use massage and electricity. Where the injury is to one of the extremities, the limb should be very carefully protected by wool or cotton, proper support being made so that no dragging shall take place, and at the end of two or three weeks the use of electricity and massage, with the administration of such internal remedies as are usually employed in such injuries, such as small doses of *nux vomica* with general tonics to improve nutrition. When all acute symptoms disappear and contractions begin to be noticed, special attention should be given to the prevention of deformities.

3. DEVIATIONS FROM SOME OF THE PHYSIOLOGICAL PROCESSES WHICH CHARACTERIZE THE EARLY LIFE OF THE INFANT.

THERE are a number of conditions and processes peculiar to the early life of the infant that are especially liable to produce pathological conditions.

Exfoliation of the Epidermis.—It is a fact that nearly all the organs and mucous membranes of the new-born are predisposed to congestion and to a catarrhal condition which is accompanied by exfoliation of the superficial layer of cells. The great delicacy of the skin and mucous membranes at this period is a decided predisposing cause to hemorrhage, and the great tendency to exfoliation readily affords entrance to the various forms of micro-organisms which produce disease. Epstein pointed out that during the first days of life, as a rule, considerable exfoliation of epithelium takes place in the mucous membrane of the oral cavity. In this cavity there are two points on either side of the posterior angle of the hard palate that in a great number of children present epithelial defects during the first days of life. Here the mucous membrane is very thin and anemic from the stretching of the pterygoid ligament in sucking and in opening the mouth. In these parts the superficial and deeper loss of epithelium occurs, especially if on attempting to wash the mouth of the new-born it is roughly handled. This shedding of epithelium is also particularly marked in the epithelium of the genital tract of female children.

Icterus Neonatorum.—Icterus of the new-born can hardly be spoken of as a disease, but rather as a phenomenon depending in many cases on natural

processes of the first days of life. It occurs in from 79 to 84 per cent. of all infants (Porak, Cruse), and is most likely to occur in children prematurely born or when ligation of the cord has been delayed. The yellow skin-discoloration occurs usually several days after birth, but occasionally it exists in the pre-natal state. The discoloration of the skin is usually not accompanied by any symptoms of disease, and is not very marked, appearing first on the face, later on the trunk. In mild cases the sclerotics remain unaffected. This usual form of *icterus neonatorum* is physiological and is without serious symptoms; it usually disappears spontaneously within a week. If the bowels are sluggish, small doses of rhubarb or *hydrargyrum cum creta* may be given. The "symptomatic" form is more serious, on account of the pathological conditions with which it is associated, and from which it must be differentiated. It is considered on another page.

There have been many hypotheses as to the cause of the usual (the physiological) form of jaundice, but no explanation has been offered that is entirely satisfactory. The two theories more generally considered are—first, that of *hematogenic* origin (Virchow's and others)—that is, the bile-pigment is supposed to originate in a rapid destruction of blood-corpuscles—and, second, the *hepatogenic* origin, in which the small common biliary duct fails to carry off excess of bile: these theories are fully described in the recent text-books on diseases of children.

Mastitis.—The mammary glands of infants, both male and female, often assume during the first two weeks a function similar to lactation in the adult woman. The milky fluid secreted closely resembles colostrum. This functional activity, being accompanied by congestion, is very likely to assume the form of inflammation, producing swelling, redness, and pain.

External irritation, such as pressure, attempts on the part of the attending midwife or nurse to squeeze out the milk, etc., increase the tendency toward inflammation. If properly cared for, this physiological swelling will soon subside; if irritated and perhaps subjected to much handling, producing abrasions of the epithelial covering, suppuration may occur. Infection of this gland is described on another page.

Prognosis and Treatment.—The prognosis is generally good. Prophylaxis occupies the first place in treatment. In cases accompanied by much swelling of the gland the latter may be dressed with vaselin and borated cotton. If swelling and redness of the skin occur, then the gland should be covered with an antiseptic wet dressing.

Diseases of the Navel.—Under this head we may consider—(1) Anatomical and physiological considerations, and dressing of the navel; (2) umbilical hemorrhage; (3) slight disturbances of healing of navel wounds; ulcerations and umbilical fungus; (4) umbilical hernia; umbilical fecal fistula; (5) diseases of the umbilical vessels; (6) omphalitis; (7) gangrene of the navel.

1. ANATOMICAL AND PHYSIOLOGICAL CONSIDERATIONS, AND DRESSING OF THE NAVEL.—Under normal conditions the umbilical cord desiccates

and drops off from about the fourth to the sixth day after the birth of the child. The cicatrix should then look clean, but it will remain moist and rather soft until the tenth or the twelfth day. The dressing of the cord should be such as to assist this normal process and to prevent the formation of moist putrefaction.

As will appear in this discussion, the umbilical wound is the commonest atrium for infection which befalls the new-born, often with most disastrous results. To prevent this accident the most explicit directions in regard to the antiseptic treatment of the umbilicus should be given to the attendants. It is not sufficient to give the nurse verbal instructions simply to dress the cord as she thinks best, but it is the duty of the obstetrician to see not only that the cord is dressed in an antiseptic manner, but that it is also kept perfectly clean until the atrium for infection at this place is closed.

Some such method as the following for treating the stump should be adopted: After cleansing the child, the abdomen and the cord should be washed with an antiseptic fluid—bichlorid solution (1 : 1000)—and the cord should be tied with a ligature that has previously been sterilized. The cord is now thoroughly washed with the same antiseptic liquid, and turned up a little to the left upon a piece of sterilized gauze. Both the gauze and the cord should be dusted over with boric acid, and then be covered by a compress of borated cotton. The cord should be thoroughly washed each day with sterilized water, and be dressed in the same manner each time. Particular attention should be paid to the stump after the cord has fallen off; it should be dressed with some antiseptic lotion, and the room in which the child is placed should carefully be guarded against all septic influences. Should decomposition of the cord take place previous to its separation, Eröss advises a dressing of bichlorid of mercury (1 : 1000).

2. OMPHALORRHAGIA (UMBILICAL HEMORRHAGE).—Umbilical hemorrhage is no disease, but rather is a symptom of one of various pathological conditions. We distinguish two classes of omphalorrhagia: First, hemorrhage from the vessels of the umbilical cord; second, hemorrhage from the umbilical wound.

Hemorrhage from the Umbilical Vessels.—Of this class there are two varieties—one occurring before, and one after, the separation of the cord.

A. *Hemorrhage before the separation of the umbilical cord* may occur if the ligature is not properly tied. The ligature may be too loose, or it may have cut into the tissue of the cord, thus opening a blood-vessel, whereupon the hemorrhage takes place. But it does not follow that in every case of imperfect ligature of the cord a hemorrhage occurs. That this statement is true we know from numerous cases where, although no ligature had been used, no hemorrhage followed. At the birth of a living child, if it has cried lustily, a small amount of blood flows from the fetal end of the divided cord ten or fifteen minutes after the cord is cut through. This blood is never the bright red oxygenated blood. After a short time this slight hemorrhage stops.

The anatomical and pathological investigations made by B. F. Schultze will assist to understand fully the above facts, as well as others relating to diseases of the umbilical cord. With the first respiration of the new-born child the expansion of the lungs leads to distention of the blood-vessels of the thorax; thus the blood-pressure sinks in all the large vessels of the body. The greatest fall of the pressure occurs in the pulmonary artery, then in the aorta, then in the other large vessels, including the umbilical artery. Thus the pulse in the umbilical cord after a deep respiration is weakened and the arteries contain little blood. At the time the arterial pressure falls one observes in the umbilical vessels an exceedingly marked muscular contraction, and notices that the lumen of the vessels is rapidly reduced.

Strawinski, who studied the peculiar arrangement of the muscles of the umbilical arteries, found in them an internal longitudinal and an external circular layer of the vessels. He and Von Basch also demonstrated, by measurement made in the lower animals, the actual reduction in blood-pressure. The umbilical cord no longer receives blood from the placenta; the blood it already held has been aspirated into the thorax, so that the vein becomes empty and its walls contracted, although less energetically than the walls of the artery. Expansion of the lungs and contraction of the muscular coat of the umbilical vessels are the two important factors which usually make severe hemorrhages from the umbilical cord of the new-born child impossible. It must be stated, also, that in many of the lower animals the tendency to hemorrhage is lessened by various conditions, such as traction of the cord and by its being bitten off. But even in the human offspring a great tendency to hemorrhage does not exist, even though the *ligature be not applied*. This fact has abundantly been corroborated by medico-legal experience, since in cases of illegitimate birth the cord is often cut by scissors and left untied, yet death by hemorrhage rarely occurs. If, however, in the new-born child the respiration is imperfect, causing only partial expansion of the lungs, then the umbilical vessels remain filled with blood and pulsate strongly.

If asphyxia of the first degree be the cause of imperfect respiration, the blood-pressure rises and the pulse becomes strong. In such a case, should the cord be severed and not ligated, profuse hemorrhage would usually follow. This fact explains most hemorrhages following imperfect ligation of the cord. When, however, such hemorrhages occur in mature and well-developed children, they must be due to insufficiency of the muscularis. Hoffman found that after birth the umbilical arteries do not contract evenly throughout their extra- and intra-abdominal extent, but that the contraction takes place in a centripetal direction. The pulsation is first weakened in the portion nearest the placenta, this weakening taking place progressively toward the umbilicus. For several minutes after the first respiration of the child there is still a full pulse-wave felt near the abdominal entrance, while the peripheral portion is bloodless and contracted.

It cannot yet be decided what causes the imperfect or only temporary contraction of the blood-vessels. It is possible that increase of arterial pressure—

as, for instance, in asphyxia—diminishes the resistance of the muscularis: some authors believe that protracted warm baths may produce relaxation of the muscularis.

For the prevention of hemorrhage a few days after birth desiccation of the umbilical stump plays an important part. If the cord dries up normally, then the dry, hard portions effect a positive protection against the eventual occurrence of hemorrhage; if, however, the cord should become gangrenous, its vessels will become distended and may again become pervious. Some authors think that any obstruction to the return of venous blood to the heart may produce hemorrhage. Inasmuch as various conditions may arise that would prevent a physiologically bloodless condition of the umbilical cord and the obliteration of the umbilical vessels, it is to be urged in every case that the cord be carefully ligated.

Prophylaxis and Treatment: Ligation of the Cord.—The ligature should be placed about two or three fingers' width from the navel. Particular care must be taken with asphyxiated or premature children that the ligature is firm and that it does not cut into the tissues; for this reason a moist tape increases the security. If the cord is very thick, a second ligature may be applied after the cord is somewhat collapsed. The tape should be from 1.5 to 2 centimeters ($\frac{3}{4}$ inch) wide; in case of hemorrhage a second ligature must be applied. If the umbilical end is too short or has been thrown off, a compression bandage must be applied or the individual vessels must be secured by encircling stitches. If the infant is anemic, stimulants must be administered and artificial heat must be applied to prevent collapse. For very gelatinous cords Budin advises the use of the elastic ligature: he found that in these cases a slight blood-pressure may suffice to produce hemorrhage, even though the cord be ligated with a linen tape. Rough handling of the stump during desiccation must of course be avoided.

B. *Hemorrhage from the Umbilical Wound.*—(Omphalorrhagia; also called "Idiopathic" or "Spontaneous Hemorrhage.")—The appearance of a few drops of blood on the dressing immediately after the separation of the cord, even though this occur for several days, is not uncommon, and generally is of no importance. The pathological condition to be here described is the one usually associated with grave constitutional disturbance, generally terminating in death. Fortunately, this form of hemorrhage is very rare; Winckel found one case in 5000 births, male children being attacked more frequently than females, and strong, healthy children more frequently than the feeble. It is of interest to note the great number of cases of umbilical hemorrhage that have been reported in America in contrast with those in Europe. The condition occurs in the negro and the mulatto as well as in the white race. Grandidier, to whom the writer is indebted for much information, collected a summary of 220 cases.

The etiology of umbilical hemorrhage is still imperfectly understood, but it is evident that hemophilia is not the only cause. In "bleeders" umbilical hemorrhage is very rare; among 185 families of bleeders, with 575 individuals

who were bleeders, spontaneous umbilical hemorrhage occurred only in nine families in twelve individuals, and in the latter it is a question whether in all of them it occurred without the bleeding of large blood-vessels. Moreover, in the cases of spontaneous hemorrhage that have recovered it has not been observed that there was a tendency to bleeding in later life, while in hemophilia the disposition to hemorrhage usually remains through life.

Grandidier offers the explanation of "transitory hemorrhagic diathesis" which has developed on account of changes in the respiration of the new-born; but this is only a suggestion as to a cause. The question is of interest whether the health of the parents, especially the mother, bears any relation to the disease. In Grandidier's cases syphilitic disease was present six times in the mother and twice in the father. American physicians state that the excessive use of alkaline remedies during pregnancy is the cause of this difficulty. Others consider the depressing influences, severe vomiting, and excessive thirst during pregnancy as possible causes. If the results of post-mortem examination are examined, it will be found that the idiopathic umbilical hemorrhage is usually associated with one of the following conditions: (1) congenital syphilis; (2) sepsis; (3) acute fatty degeneration; (4) hemophilia.

Syphilis is a cause of umbilical hemorrhage. Not alone Grandidier, but other authors have found syphilis of the parents present in many cases of umbilical hemorrhage in children. The description of the syphilitic changes which the child showed during life, and which were found post-mortem, is sufficient to establish syphilis as an etiological factor. This opinion is rendered still more certain by the general tendency to hemorrhage in congenital syphilis. In cases of marked hemorrhagic diathesis it may happen that the hemorrhage takes place from the umbilical wound as well as from other organs.

Sepsis.—The observations of Weber, Ritter, and Epstein leave little doubt that sepsis of the new-born may give rise to idiopathic umbilical hemorrhage. It is known that capillary hemorrhages are of frequent occurrence in sepsis, but severe hemorrhages in various organs are also observed. Most of these cases were observed in orphan asylums. Epstein found among 51 children with this form of hemorrhage that 24 were suffering from acute septicemia. Extensive gangrene of various parts of the surface of the body is frequently associated with this form of hemorrhage.

Klebs and his follower, Eppinger, attribute the hemorrhages to the invasion of a micrococcus, the *monas hemorrhagicum*. Often the blood-vessels in the neighborhood of the hemorrhage were filled with these micrococci, which were also found constantly in the blood. According to Cohn and Weigert, many cases of hemorrhage have been observed in which bacterial thrombus and embolism are the cause of the extravasations.

The occurrence of umbilical hemorrhage in *acute fatty degeneration* will be found fully considered on another page.

Symptoms and Physical Signs of all these Forms of Hemorrhage.—The

hemorrhage generally manifests itself about the fifth day, usually just after, occasionally before, the separation of the cord. According to Minot, it may occur as late as the second or the third week; the subject may be well developed and apparently healthy. The hemorrhage does not arise from one or two distinct vessels, but oozes freely, like a fluid from a sponge. The bleeding may at first be so slight as to be mistaken for the physiological process above referred to, but its real significance will be manifested by the persistent oozing or in a hemorrhage so severe at first as rapidly to exhaust the strength of the little patient. There is often slight icterus, sometimes vomiting and colic, clay-colored stools, sometimes bloody discharge from the stomach and bowels; in severe cases cyanosis and somnolence are present, showing that there is a marked and grave constitutional disturbance. In the neighborhood of the umbilicus occur spots of ecchymosis, that also appear in other parts of the body, so that the whole child appears mottled with bluish-red spots. Edema of the ankles and the hands frequently occurs, and it may extend to other parts of the subcutaneous connective tissue. Death may follow in several hours, but the patient may live for two or three weeks. Grandidier's statistics show a mortality of 83 per cent. Death is preceded by symptoms of collapse, coma, and occasionally convulsions.

Differential Diagnosis.—The diagnosis of this form of umbilical hemorrhage from the more common form first described is based on the grave constitutional disturbance which soon follows, and on the great difficulty, usually the impossibility, of checking the hemorrhage.

Therapeutics.—Since omphalorrhagia is a symptom of a number of constitutional diseases marked by a tendency to hemorrhage, the treatment directed solely toward the arrest of hemorrhage will scarcely suffice. Usually all attempts at arresting the hemorrhage are futile. The employment of a styptic is only a temporary measure; it may be combined with firm pressure upon the wound. The most successful treatment consists in ligature of the navel according to Dubois' method. A hare-lip pin is passed along the edge of the umbilical wound from left to right in such a way that the skin, but not the whole thickness of the abdominal wall, is included. By means of a thread passed beneath the pin the navel is now raised, and a second pin is passed under the first pin, and at right angles to it, through the abdominal wall. A figure-of-8 ligature is passed around the second pin, and, finally, circularly around the base of the navel. This method is said to have arrested the hemorrhage in a few cases. A plaster-of-Paris bandage has been advised. The attempt to search for the vessels with a view to ligating them is almost never successful. Hemorrhages occurring in other parts of the body are to be treated in a similar manner. The internal treatment should be directed to the cause, but thus far promises very little.

3. SLIGHT DISTURBANCE IN HEALING OF NAVEL WOUNDS.—Occasionally when the process of desiccation of the cord has been incomplete, or when there has been some irritation of the navel by friction, especially when not kept perfectly clean, excoriation and even ulceration may occur. In this

event the treatment consists in cleansing the wound with an antiseptic solution (3 per cent. boric acid) and in applying a mild astringent. Runge advises salicylic acid and starch (1:5 to 1:3). The stump in these cases should be dressed twice a day.

Umbilical Fungus.—If the wound heals slowly and secretes for a long time sero-purulent fluid, there sometimes then develops a red granular growth which bleeds readily, and from which there is more or less oozing of serous or sero-purulent fluid. This growth in some cases has a broad base; in other cases one or more of the growths are pedunculated, soft, and not sensitive. In the early weeks these growths may be visible only on retracting the surrounding integument, but later, if not arrested, they may form an elevation of considerable extent surrounded by excoriations. Usually the health of the child does not suffer. The fungus itself is not sensitive, but the surrounding excoriation may become painful. Histologically, this fungus is a granulation tumor. The wound in the navel, as a rule, cannot heal while the fungus exists, although in very exceptional cases the growth may become covered with epidermis. This disease must be differentiated from the adenoma described by Küstner.

The treatment consists in cauterizing the growth with nitrate of silver and applying a salicylic-acid bandage. Removal by scissors is likely to produce considerable hemorrhage.

Diseases of the umbilical vessels, omphalitis, and gangrene of the cord are considered on other pages of this work.

4. **UMBILICAL-CORD HERNIE** (*Herniæ Funiculi Umbilicalis*).—Umbilical-cord hernia depends upon the arrest of development of the abdominal wall in the first stages of fetal life. Frequently other malformations are present, such as hare-lip, club-foot, hydrocephalus, and spina bifida. Lange found from a study of 21 cases collected in literature that in seventeen of them other malformations were also present. There will be considered in this discussion only such cases of umbilical-cord hernia as are not associated with other malformations which interfere with life.

Anatomy.—The umbilical-cord hernia is a round or an oval swelling in the umbilical region, varying in size from a nut to that of an orange; occasionally larger. The tumor may occupy the greater part of the abdominal wall. The hernial sac consists of peritoneum, covered by the amnion which originates from the umbilical cord and reaches the base of the swelling. The base of the swelling is continuous with defective integument. Sometimes a small part of the skin reaches a little over the tumor. Between the external covering and the peritoneum is a thin layer of Wharton's jelly. The amnion and peritoneum may be firmly united. The sac usually contains some intestine, at times also the liver, stomach, spleen, and other viscera, such as the kidneys and pancreas. Two or more of these viscera may be bound together by adhesions. The implantation of the umbilical cord is sometimes on the summit of the swelling, more often somewhat deeper. The umbilical vessels pass from the cord between the amnion and the peritoneum over the swelling to

the abdominal defect, the veins passing to the liver and the arteries toward the bladder.

Clinical Appearance.—Immediately after birth the thin amniotic covering of the umbilical-cord hernia presents a grayish-white, translucent appearance; the presence of meconium in the intestines gives the swelling a dark green color. On palpation one may detect peristaltic motion of the intestine; the presence of a part or of the entire liver renders the contents of the tumor firmer. During the process of desiccation in the umbilical cord in the next few days the appearance of the hernia is much changed. The circular edge of skin at the base is reddened, and suppuration often takes place. After separation of the amnion active granulation may build up the edge of the ulcer. The wound-surface grows less, the edges contract, and finally the hernia may close by cicatricial contraction. Death often results. By rough handling the hernia may become gangrenous; in this case the gangrene is liable to extend into the contents of the sac, and the child dies of sepsis. In other cases suppuration extends along the umbilical arteries or directly to the peritoneum, and death is due to arteritis umbilicalis or to peritonitis.

Diagnosis.—A case of large umbilical-cord hernia can scarcely be mistaken for anything else. Small herniæ of cylindrical form are more apt to lead to error in diagnosis. In all cases of marked swelling of the umbilical cord at its fetal insertion one should think of the possibility of hernia of the cord.

Prognosis.—Formerly the prognosis was considered always bad. In 1884, Lindfors taught that healing without operative measures might be procured by suitable retention. Previous to his time cases of healing by protection and compression had been reported. More recently the prognosis has become somewhat more favorable, but the mortality still remains high.

Treatment.—The treatment has already been indicated. It consists of two methods: first, favoring natural tendency to obliteration; and, second, the radical operation. The first method consists in favoring desiccation by applying careful antiseptic dressing of iodoform, aristol, zinc, or bismuth. The hernia should be protected by a cotton compress, and when the cord and amnion have dropped off granulation of the edges must be favored by the application of solutions of nitrate of silver. As soon as reduction seems possible it must very carefully be performed, and a compression pad be applied and held in place by adhesive straps.

Radical Operation.—If this method is chosen, the operation should be performed soon after birth. In this case all efforts at reposition are omitted. Twenty-four hours previous to the operation iodoform dressings are applied. The operation consists in making a circular incision into the skin at the base of the swelling, .2 to .5 centimeter ($\frac{1}{4}$ inch) outside of the sac, cutting down close to the peritoneum. After examination of the contents and separation of adhesions the abdominal wall is closed by interrupted sutures, taking care to bring the edges of the skin into perfect apposition.

In 1883 to 1889, Lindfors in his collection of 10 operative cases had seven recoveries. Since then he has added to the number. MacDonald in 1890 had

19 cases with seventeen recoveries. Since then other operators have met with happy results.

4. INFECTIOUS DISEASES OF THE NEW-BORN.

It has long been observed that occasionally a child born in apparently perfect health, with good family history and with excellent hygienic surroundings, has developed during the first days of its life a disease characterized by high temperature, exhaustion, collapse, and death. Sometimes there has been found a local trouble which explained the cause of these phenomena, but frequently nothing could be noticed.

Frequency.—The occurrence of infection of the new-born is probably greater in private practice than is generally recognized. It is fair to suppose that in many infants attacked with fever and prostration, accompanied possibly with some jaundice and continued exhaustion, a fatal result takes place from septic infection. In hospitals a high percentage has always been acknowledged. Miller found that 700 or 800 deaths occurred yearly from different forms of sepsis of the new-born.

Etiology.—In considering the etiology of sepsis of the new-born we cannot avoid some reference to the subject of sepsis *in utero*. After an extensive search through medical literature Von Holtz positively asserted that although septicemia *in utero* was rare, it undoubtedly occurred. For this early form of sepsis the two modes of genesis which have been assumed, and which have given rise to considerable debate and experimental research, are *placental infection* and *infection by aspiration of the amniotic fluid*. Although the placental transmission of septic micro-organisms from the mother to the fetus has not fully been demonstrated, either clinically or experimentally, this possibility can hardly be denied. Several cases accurately described by Weber, Buhl, and Orth leave little doubt as to this mode of infection. The theory of fetal sepsis produced by the aspiration of either putrid amniotic fluid or genital secretions seems probable from a case described by Küstner; experiments made by Hohenhausen and Geyl are cited in support of this theory, but the evidences are not conclusive.

Many other theories have been advanced on the means by which the organism of the new-born may be invaded by infectious matter. P. Müller made experiments to prove that disease-germs are transmitted from mother to child by means of the mother's milk. There has been demonstrated, on the one hand, the presence of staphylococci in the milk of septic puerperal women, but, on the other hand, since staphylococci have been found in the milk of healthy women, and since such milk has not been injurious to the children who were nourished by it, since also children nursing from women with septic diseases have remained healthy, the question of sepsis being transmitted through mother's milk must still be considered unsolved.

Air-infection is another theory, according to which the fetus that has aspirated amniotic fluid will contain a favorable culture-medium in its lungs for pathogenic germs that may exist in the sick-room.

Pathology.—Pathological conditions will differ according to the cause of the infection. In some cases the infection-atrium cannot be found: if it is the navel, diseases of blood-vessels will be found, with evidences of septic peritonitis and inflammation of other abdominal organs. If the infection has taken place through the mucous membranes, we find the pathological conditions present in the mouth, the larynx, and the upper air-passages, as well as in the intestinal mucous membrane. Evidences of septic pneumonia with bloody exudate into the pleura and pericardium have been found. Sometimes hemorrhages have taken place into the brain, the lungs, and the kidneys. This result is due partly to diseases of the liver and partly to inflammation of the veins of the umbilicus.

Symptoms.—The manifestations of infection of the new-born necessarily vary as different organs are involved or as the entire system is invaded. Many of these cases of infectious disease are characterized by a rapid loss of weight and by restlessness and insomnia. There is usually a rapid and shallow respiration, attended with vomiting and diarrhea. The temperature is frequently 105° F., but in some cases where the infection is profound collapse will early occur. Some of these attacks, with symptoms that are exceedingly severe for a short time, are aborted. In other cases nothing is observed until about the fifth or the seventh day, when usually there will be found in the region of the umbilicus some evidences of suppuration, or at least some redness, with possibly a bad odor. These symptoms are sometimes followed by diphtheritic exudates in different parts of the body. The child is fretful, its temperature rises to 102° F. or higher, very frequently the abdomen is hard and tender, and septic peritonitis and death follow.

Other symptoms, such as icterus and melena, may be associated with sepsis. They are not invariably present, and are sometimes described as special diseases. *Icterus*, in its general application, is considered on another page, but its special relation to sepsis will be considered under *Icterus Symptomaticus*, also under *Gastro-intestinal Hemorrhage*.

In other cases the symptoms are those which would come under one of the conditions presently to be described—infection of the umbilicus, erysipelas, mastitis.

Wound-infection.—The atrium for infection in the great majority of cases is doubtless through some wound, such as traumatic injuries due to delivery, or lesions of the mucous membranes due to physiological processes of desquamation, but, most frequently of all, through the umbilical wound. Prof. J. Lewis Smith makes the following classification: 1. Umbilical phlegmon, or local sepsis; 2. Sepsis following the introduction of poison through the umbilical vein; and 3. Sepsis received in other ways or through channels other than the umbilicus.

A. INFECTION THROUGH THE UMBILICUS.—This condition includes many of the abnormal conditions of the navel. The milder forms of infection interfering slightly with a normal healing process or producing ulceration are considered on page 832. The graver forms of infection of the umbilicus are diseases of the umbilical vessels, omphalitis, and gangrene.

Diseases of the Umbilical Vessels—Arteritis and Phlebitis.—According to Runge, arteritis and phlebitis of the umbilicus are of septic origin, the former occurring more frequently than the latter. The infection first attacks the perivascular connective tissue, extends to the adventitia, and produces dilatation and thrombosis, after which the disintegration of the thrombus may induce general sepsis, the infection being conveyed through the lymphatics. (Occasionally localized disease of the vessels may produce death.

Symptoms.—There are no symptoms which would indicate with certainty the existence of arteritis or of phlebitis of the navel, but we can infer that these conditions exist where local ulcerative or suppurative processes are associated with much constitutional disturbance. The course of the diseases is often acute. A child who is apparently well may suddenly manifest restlessness, followed by collapse and death. At other times there are the usual symptoms of general sepsis.

Diagnosis, Prognosis, and Treatment.—The diagnosis usually cannot be made definitely until after death. Cases of the milder form, occurring in children who are well developed, usually recover. For children prematurely born the prognosis is grave. The treatment consists in the use of antiseptic dressings, and in adopting all possible means to support the strength by nourishment and alcoholic stimulants.

Omphalitis.—This affection is an inflammation of the navel with phlegmon of the surrounding tissues. In the region of the navel there is a red swelling, at the apex of which the navel may be observed. Usually the healing of the wound is incomplete. The redness and inflammation extend in a circle around the stump, the skin is tense, without wrinkles, and glistening, and the abdominal wall is hard, infiltrated, and very sensitive. This infiltration may involve the greater part of the abdominal wall, and may even extend to the deeper tissues down to the peritoneum. The child is restless, has fever, pain upon every motion, even on respiration, and consequently assumes a fixed attitude; respiration becomes costal, the lower extremities are drawn up toward the abdomen and are held immovably in that position. On the surface of the abdomen dilated veins may be seen. The disease may last days or weeks. It usually begins in the second or the third week. The termination is favorable if the disease is not too extensive, but if inflammation involves the abdominal wall, peritonitis is likely to follow. If the navel vessels become diseased, gangrene may result.

Prognosis and Treatment.—The younger the child the more favorable is the prognosis. The treatment consists in the use of antiseptic dressings, of which salicylic acid and iodoform are the best. If suppuration takes place, the pus must be evacuated early. The constitutional treatment is the same as that for arteritis and phlebitis.

Gangrene of the Navel.—Gangrene arises from ulcers of the umbilicus, from general inflammation due to sepsis, and from cholera infantum. As a local infection of the navel it is not infrequent, especially when the patient is neglected.

Symptoms.—The margin of the wound of the navel becomes discolored and there is more or less oozing of a muddy fluid, or, in omphalitis, a vesicle may form containing turbid fluid. When this vesicle bursts it leaves a raw surface. The spreading of the moist gangrene may be rapid, may largely be on the surface of or deep in the navel; the latter condition is the most dangerous. There is always fetid odor. If the child is strong, then the process may become arrested and the defect may heal by granulation, but usually there is rapid loss of strength, terminating the second or the third day in death. Gangrene following cholera infantum usually terminates rapidly in general sepsis and death, but this fatal termination has occurred as late as the twenty-third day. Peritonitis sometimes occurs in which perforation of the intestines may take place, leaving a fecal fistula. Profuse hemorrhage is one of the probable complications.

Treatment.—A 3 per cent. solution of acetum aluminum, applied with a compress covered with rubber cloth, acts antiseptically and hastens the separation of the slough; after that the indications for treatment are to support the strength by nourishment and alcoholic stimulants.

B. INFECTION OF OTHER WOUNDS.—Various injuries upon the body of the child may lead to wound-infection the same as occurs in the navel wound. In pre-antiseptic times frequently small, insignificant injuries of the skin of the child from pressure of the forceps were followed by phlegmonous inflammation about the injury, and sometimes by general sepsis. The infection in such cases was transmitted by unclean instruments or hands during labor or after the birth of the child. In a similar manner various infections may follow if operations are done upon the child and asepsis and antisepsis are not observed, as in opening a cephalhematoma, in operating for umbilical hernia or spina bifida, in opening a mammary abscess, etc. It may occur in the cutting of the band in a tongue-tied child or through the ritual of circumcision. The most frequent entrance of infection is through the defects in the epidermis and mucosa produced by the tendency to exfoliation referred to on page 826.

The infection may also take place about the buttocks if the bed or the clothing be impregnated with septic material. Infections about the mouth and the buttocks may lead to severe intestinal inflammation. Through the mucous membrane of the genital tract of the female child infection may also take place on account of the shedding of epithelium, and the infection may take on a diphtheritic nature and lead to gangrene of the external genital organs, terminating in the death of the child. Gonorrheal infection from the parturient canal of the mother is doubtless often transmitted to the genital tract of the female child, leading to obstinate leucorrheal discharges which occur in early life.

Erysipelas.—Upon taking up a work on *Diseases of Children*, written in 1800 by Michael Underwood, the writer found under the head of "Infantile Erysipelas" a description of unquestionably septic processes which to-day would be charged to bacterial infection. The writer is tempted to quote freely

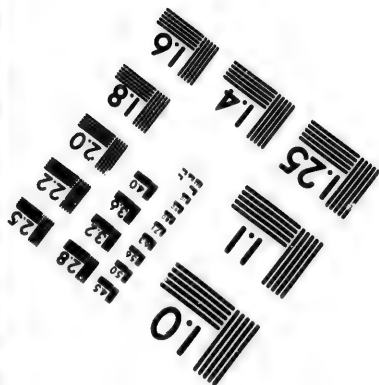
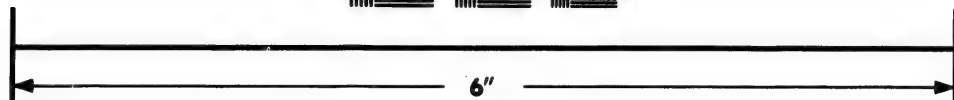
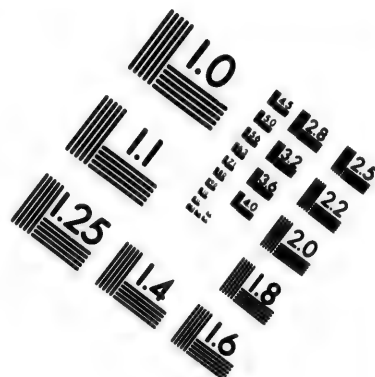
from this old work, both from the general interest in a voice from the past and from its particular aptness and historical value. The author says: "This disease does not appear to be distinctly noticed by any preceding writer. The French have, indeed, spoken lately of a somewhat similar affection, combined with other complaints infesting crowded hospitals, but the disease does not appear to have been anywhere noticed in its simple and genuine form. I think it may with propriety be termed the Infantile Erysipelas. It is a very dangerous species of that spurious inflammation, and it is not very often met with outside of lying-in hospitals. The ordinary time of its attacks is a few days after birth, but it is sometimes met with much later. It seizes upon the most robust as well as delicate children, and in an instantaneous manner; the progress is rapid; the skin turns of a purplish hue, and soon becomes exceedingly hard.

"The milder species of it appears often on the fingers and hands or the feet and ankles, and sometimes upon or near the joints, forming matter in a very short time. The more violent kind is generally seated about the share-bone (or pelvis), and extends upward on the belly and down the thighs and legs, though sometimes it begins in the neck, and is equally fatal." (The author believed it more dangerous as it affects the central part of the body.) "In a few instances the disease has been attended by some varieties. Infants have not only come into the world with several hard and inflammatory patches and ichorous blisters about the belly and thighs, but with other spots already actually in a state of mortification."

Since the time of Underwood it has been noticed that epidemics of puerperal infection have been followed by deaths of a considerable number of children from erysipelas or local phlegmon or from diseases of the internal organs not so easily differentiated. It has remained, however, for the new pathology of the present generation to give a fair explanation of its etiology.

It has been found, on the one hand, that no micro-organisms are present in vessels of the stump of the navel cord which has been removed under the strictest antiseptic precautions; on the other hand, it has been demonstrated that germs of various diseases exist in the cord and blood-vessels of children who suffer from symptoms which have been named above.

The following is the history of a case of erysipelas vulvæ: C. B., age three months, twin, female. Four days after the boy twin was circumcised by a rabbi the baby girl was taken sick. The preputial wound of the boy healed nicely after having a slight purulent secretion for a few days. Diapers were used in common for both babies. The temperature of the female twin was soon 105° F., pulse 140, and there were swelling and redness of the labia, in a few hours extending to the thighs and lower part of the back. The redness was shiny, and clearly defined with slightly raised margin. On the second day the process had extended over the entire back. On the evening of the second day the temperature was 105° and the pulse 160, and the child was restless. There was typical Cheyne-Stokes respiration. During the next three days the process abated over the back, but extended downward, involving thighs, legs,



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and feet. At the end of twelve days the swelling and redness had all disappeared. As soon as the process began to lessen on the trunk and extend to the lower extremities the condition of the patient began to improve.

Peritonitis.—Acute peritonitis in the new-born is always septic, and it usually results from the absorption of septic material at the umbilical wound or from umbilical phlebitis or arteritis. It is almost unknown in private practice. Runge found only four cases of peritonitis among 55 post-mortems in infants dying of umbilical arteritis and of septicemia the result of puerperal infection. In puerperal peritonitis death most commonly occurs within a week. Pleuro-pneumonia occasionally exists in these cases of septic infection.

Symptoms and Treatment.—The early *symptoms* are usually those of erysipelas around the base of the cord. There may be vomiting, diarrhea, jaundice, distention of the abdomen, fever, and wasting. The *treatment* of both peritonitis and pleuro-pneumonia at this early period of life consists chiefly of prophylactic measures. When the diseases have appeared, notwithstanding prophylaxis, the main reliance is free stimulation.

Phlegmasia.—This disease, which takes place in a considerable number of infants, is analogous to phlegmasia in adults, except in certain modifications with respect to the special anatomy of the first days after birth. It is undoubtedly a septic infection, usually associated with septic disease of the blood-vessels of the cord.

Parotitis.—A case of suppurative parotitis with a fatal result, and septic infection through the umbilicus, producing endocarditis, and resulting fatally at the eighth week, has been placed on record.

Mastitis.—The milder form of mastitis has been described on page 827. The mammary gland often gives entrance to infection, either by way of the milk-ducts or through slight injuries to the nipple, owing to improper manipulation or from pressure or bruising of the gland. If, in case of slight infection, the little gland is carefully guarded against new invasions, and is dressed with boric acid or with a solution of the bichlorid of mercury, the hardness and pain usually disappear, and the result will be all that one could desire. If, however, the breast is mechanically irritated, and thus made more vulnerable, and if attention to cleanliness be neglected, pus in all probability will form.

Symptoms.—The infection begins usually in the second week of life, with marked redness of the overlying skin and increased tenderness upon pressure. If at this point the disease is not averted, then there is an increase in the swelling, redness, and tenderness. The diseased gland becomes increased in size, usually in circumscribed portions. With the developing redness of the skin there are formed in the gland abscesses which finally rupture and discharge one or two teaspoonfuls of pus. During the abscess-formation the child is restless and its temperature high. After the discharge of the pus convalescence is usually uninterrupted and the cavity rapidly heals. Secondary abscesses are seldom formed; the disease usually involves but one of the

glands. In other cases the disease does not remain limited to the gland, but extends to the surrounding tissue; it then becomes *perimastitis*. In this case the extension of the infiltration may be very great, reaching to the axillary space. Then the temperature rises very high and there is rapid loss of weight. As soon as the abscess is opened the symptoms abate. The contents of these abscesses may be very fetid and contain sloughs of tissue. In such cases death from sepsis has been recorded.

Dr. Bush narrates the following extremely interesting case of sepsis of the new-born: A healthy child, born at full term, weighing nine pounds. In seven days the cord fell off, leaving a granulating surface. On the fifth day of life the mammary glands were swollen and some fluid exuded. In two days there was greater swelling in the left, but not in the right, side. Five days later (twelfth day) the entire right side, half of the thorax from the middle of the sternum to the axillary line, were hot, swollen, hard, dusky-red in color, with fluctuation about the breast. Green stools and fever were present. Opening of the abscess evacuated 30 cubic centimeters (1 ounce) of sero-sanguinolent fluid with some tissue. There was a constant discharge of bloody, foul-smelling matter, but for the time the child improved. Two days later there was a second opening, and ultimately large ulcers formed, which extended to the ribs, so that the pleura lay naked at the bottom of the wound, death taking place at the end of ten weeks.

The prognosis is generally good, but in the development of the glandular function at a later period of life atrophy of the diseased gland may follow. In female children this atrophy may interfere with the function of lactation later in life; it may also lead to retraction of the nipples.

Treatment.—The prophylactic treatment for mild forms of mastitis has been indicated on page 827. If swelling and redness of the skin occur, then the gland should be covered with a wet antiseptic dressing. If suppuration occurs, the abscess should be opened early. The incision is made in the direction radiating from the nipple; the after-treatment is according to general surgical principles. If the tissues outside the gland are involved, then early incision is indicated. Carbolic preparations in the treatment of these wounds should be avoided. The little patient's strength must be supported by appropriate food and stimulants.

Tetanus Neonatorum.—This disease consists of tonic spasms of the masseters, extending rapidly to the voluntary muscles. The disease usually begins at the time of the separation of the stump of the cord—that is, from the fifth to the ninth day after birth. It is now much less frequent than in former years. An examination of early literature on pediatrics shows that in olden times death from this disease very frequently occurred.

Etiology.—Formerly the cause of this disease was assigned to various conditions; dense population was thought to be a predisposing cause, locality another (Keating). It is particularly common in the tropics. In East India and in Africa the disease is particularly fatal; in Jamaica 25 per cent. of the negro children die each year. In New Orleans and in Baltimore the mortality

from this source was formerly very great. Pressure upon the brain and neglect of ordinary care of the infant were also considered special causes; upon closer study, however, it seems that one cause, common to all, is filth.

According to the recent teachings of Pathology, tetanus is a wound-infection (Brieger) produced by the tetanus bacilli, inoculating, as a rule, the navel wound and there producing ptomaines (described by Brieger), of which *tetamin* is the most characteristic. Any wound of the new-born may thus be inoculated. It has been proven that these bacilli occur upon the surface of the earth, particularly in the dust that accumulates upon the floors of houses. It is easily understood how in this way the bacilli may be introduced into a wound, especially under conditions unfavorable to asepsis. It is also apparent why in tropical regions, in crowded cities, and among the poor this disease has been of such frightful prevalence. Hartigan and Hirsch describe the disease as occurring very frequently among the negroes, with whom it is a practice to apply to the navel the roots of certain plants.

Pathological Anatomy.—Autopsies have thus far shown nothing characteristic of the disease. There are usually exudates of bloody serum in the spinal meninges, and some extravasations of blood which may be the result of the violent spasms. Similar changes are found in strychnin tetanus. The other organs show nothing characteristic or constant. The navel wound may seem perfectly normal; occasionally there is suppuration of the wound and some disease of the vessels.

Symptoms.—The most marked symptoms are those pertaining to the muscular system. Premonitory symptoms are usually present for many hours, and sometimes days: restlessness, sudden cries during sleep, difficulty in nursing, rigidity of the muscles of mastication, these muscles being as hard as wood. The mouth cannot be opened, the lips are pressed together, sometimes protruding; the brow is corrugated; at times there is an extreme sensitiveness of the entire surface of the body. Later there is difficulty in swallowing, which frequently becomes impossible. Pulse and respiration are frequent, and there are sometimes diarrhea and urinary disturbances. When the muscles of mastication are involved, this condition is called "trismus;" when there is general rigidity of all the muscles, we speak of it as "tetanus." The opisthotonos by this time is particularly noticeable, and the abdomen is also hard; the arms and hands are flexed. As a general thing, however, the muscles of the body are less involved than those of mastication; the convulsions are at first clonic, becoming after awhile continuous. The respiratory muscles are only slightly affected. Spasms of the laryngeal muscles may cause sudden death. Laceration of muscles and fracture of bones have occurred as complications of the disease; paralysis of groups of muscles may remain.

Diagnosis and Prognosis.—The diagnosis is based on spasm of the masseter muscles, followed by opisthotonos and general hyperesthesia. Unless treatment is commenced early the outlook is unfavorable. The attacks become more fre-

quent and more intense, the patient loses flesh, hyperesthesia of the skin accompanies rigidity of the muscular system, and finally death takes place.

The prophylactic treatment consists in observing absolute cleanliness on the part of the attendants. The antiseptic treatment of the umbilical wound must be insisted upon. Long before the nature of tetanus was understood cauterization of the umbilical wound was employed. When the disease is fully developed, its management consists in making the symptoms as light as possible and in supporting the strength of the child. The little patient should be isolated. The first indication is usually met by means of narcotics, among which chloral is useful: $1\frac{1}{2}$ grains may be given by the mouth, and twice that amount by the rectum; 15 to 30 grains may be given per diem. Opium does not meet with much favor. Chloroform inhalations are also useful. The action of the narcotics is increased by the use of hot baths every one to three hours. A great many other narcotics have been recommended, such as the bromids, extract of Calabar bean, atropin, etc.

Icterus Symptomaticus.—The icterus which is often associated with infectious disease is designated the "symptomatic form of icterus." It occurs in septicemia, in syphilis, in Winckel's disease, and in Buhl's disease. It is this association with grave constitutional disturbances that distinguishes it from the mild form described on page 826. In this grave form the discoloration is more marked, the sclerotic is usually deeply tinted, and there is rapid loss of body-weight. There is also marked increase of urea and uric acid in the urine.

The pathological conditions at this time of life that are most commonly met with in icterus are—obliteration of the hepatic duct, due either to congenital stricture or to syphilitic perihepatitis, septicemia, Buhl's disease, and Winckel's disease.

Treatment.—The treatment for icterus is indicated by the condition on which it depends.

Buhl's Disease (Acute Fatty Degeneration).—*Pathogenesis and Etiology.*—In 1860, Buhl described a disease whose anatomical characteristics were parenchymatous inflammation and fatty degeneration and hemorrhages in the heart, the liver, and the kidneys. The cause of this disease is not yet known. Some authors deny, while others accept, a septic infection (Müller). Bigelow found micro-organisms in the organs in cases of acute fatty degeneration.

Pathological Anatomy.—The body is cyanotic, and it usually shows icterus and edema; not seldom ecchymosis is found in the skin. The umbilical wound and vessels are normal. In almost all the internal organs hemorrhages the size of a pin-head or larger are found; they are also found in the meninges, the pleura, pericardium, peritoneum, thymus gland, and muscles. In the lungs hemorrhagic infarcts occur, and bloody mucus or clear blood is found in the bronchi. In the heart-muscle, the liver, and the kidneys fatty degeneration is present. In the stomach and intestines much blood is found; the kidney parenchyma presents many hemorrhagic foci; the spleen-pulp is very soft.

Symptoms.—Most of the children with Buhl's disease are born asphyxiated, although the labor is easy and rapid. The asphyxia is but partially, or not at all, overcome. Deep inspiration and lusty crying do not occur, and soon severe cyanosis supervenes, at which time many of these children die. If death does not occur, there follows upon the evacuation of the meconium a diarrhea, with some blood, and later entirely bloody stools and the vomiting of blood. With the separation of the cord there frequently ensues parenchymatous hemorrhage from the umbilical wound. At the same time hemorrhage from the mucous membrane of the mouth, the nose, the conjunctivæ, and from the external ear and skin, takes place, whereupon icterus develops, which in long-continued cases becomes extreme. Later, edema of the skin occurs, and death from collapse follows, without any marked elevation of temperature, usually about the end of the second week. Death may be preceded by only one of the above symptoms, such as cyanosis or hemorrhage. Buhl's disease is rare, and has only been seen in lying-in hospitals.

Diagnosis, Prognosis, and Treatment.—The *diagnosis* has rarely been made during life, and only positively post-mortem after microscopic examination of the fatty organs. The *prognosis* in this affection is always fatal. The asphyxia is treated on general principles, and every effort must be made to support the strength of the patient.

Winckel's Disease.—*Symptoms.*—In 1879, Winckel described a disease, observed in the Dresden lying-in hospital, that was characterized by cyanosis, icterus, hemoglobinuria, somnolence, and rapid collapse without fever. Twenty-four cases were observed, only one of which ended in recovery. The sickness began with restlessness and cyanotic discolorations, after which there occurred icterus, vomiting, and diarrhea, and later convulsions, collapse, and death. The urine was pale brown, owing to the presence of hemoglobin. The urine contained also renal epithelium, granular casts with blood-corpuscles, micrococci, detritus, and some albumin. The urine was of a syrupy consistence, dark brown, and could be expressed on the cut surface of the kidney only on firm pressure. The mothers of the sick children all remained well.

Pathological Anatomy.—The condition of the kidneys was characteristic. The cortex was of a brown color and was beset with hemorrhagic spots. The pyramids were dark red, with infarcts of hemoglobin in the apices. In the bladder there was dark urine. In almost all the organs and in the serous membranes punctiform hemorrhages were found. Moreover, there was, as a rule, swelling of Peyer's patches and of the mesenteric lymph-glands. In the blood the white corpuscles were increased and the red ones enlarged, and fine granular bodies in rapid motion were seen in the plasma. The liver, and at times the heart, showed fatty degenerations. The liver and the kidneys in some cases presented collections of bacteria. Cyanosis and jaundice of the external skin and internal organs were observed.

Two similar cases were previously observed by Parrot (1873); further, Bigelow saw ten epidemic cases, and several sporadic cases were noted by Epstein in the foundling hospital of Prague. Two such cases have been

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described by Herz. In all the cases hemoglobinuria was absent or not looked for.

Etiology.—The last-named two authors claim a septic origin of the disease. Winckel could not discover the exact cause of the disease. Poisoning by phosphorus, potassium chlorate, carbolic acid, and arsenic could surely be excluded.

Melena Neonatorum.—Melena means, literally, "black disease," on account of the black (bloody) masses which are vomited or passed in the stools. According to our present knowledge, it is difficult to classify this condition, inasmuch as it must be regarded as a symptom of one of several diseases. It occurs in general sepsis, in syphilis, and in Buhl's disease. Some authors speak of it in connection with hemophilia. The condition is fully described under *Gastro-intestinal Hemorrhage* (p. 853).

Pemphigus.—Pemphigus neonatorum, apart from syphilis, is rare in infants, and is characterized by the appearance upon the skin of numerous vesicles, which develop rapidly, then rupture, and soon dry up. There then remains a moist surface, which heals after a few days without the formation of a cicatrix. Each vesicle is placed upon a reddened base. The vesicles consist of a raised superficial portion of the epidermis with exudates beneath. The vesicles are round or oval, and vary in size from that of a pea to that of a pigeon's or a hen's egg, and have considerable resemblance to burn-blisters. Their number is variable; there may be a single vesicle or a great part of the body may be covered with them. The vesicles contain a yellowish serum, which may later become more turbid and of a purulent appearance. The vesicles appear by preference on the abdomen, around the navel, or on any part of the trunk, or the head, and less frequently on the extremities, rarely on the palms of the hands and soles of the feet, a fact of considerable value in differentiating syphilitic pemphigus. The eruption on the extremities is usually not marked. The vesicles generally develop suddenly, occasionally over night; previous to the eruption the child may, but ordinarily does not, manifest irritability and disturbance of health; the eruption is prone to occur in successive attacks. The disease begins from the fourth to the ninth day of life; after the fourteenth day up to the third week its course, as a rule, is ended. Usually fever is absent. In very severe cases high temperature may occur, followed by exhaustion and death. As complications and sequelae there may occur furunculosis and other ulcerative processes leaving scars. Umbilical suppuration and disease of the umbilical vessels are described as complications in fatal cases.

Etiology.—There seems to be no doubt that pemphigus of the new-born is an infectious disease. It occurs in well-described epidemics and endemics, partly in cities and partly in asylums, sometimes in the practice of a single midwife. Many epidemics have been observed since 1834 in maternities in cities and in the practice of midwives. The first cause of such epidemics still remains undecided. Often these epidemics may be traced to a single person. The disease has been transmitted from the nursing infant to the mother or the wet-nurse, manifesting itself on the mammary gland, but, as a rule, the infec-

tion of adults is rare. It is probably of bacteriological origin, but the specific germ has not been demonstrated. This eruption must not be confounded with that of congenital syphilis, although there is some resemblance between them.

The treatment of pemphigus consists in protecting the blisters from injuries; in case of rupture of the vesicles starch or pulverized salicylic acid and starch should be applied. Where the eruption is excessive warm baths give much comfort. After the bath the patient is wrapped up in cotton. In case of ulceration this should be treated on general principles.

Syphilis.—Syphilis in early infancy naturally comes under two heads, the acquired and the hereditary form. The hereditary form is considered under *Diseases of the Fetus in Utero* (p. 297).

Etiology.—According to Fournier, children acquire syphilis more often than is usually supposed. The causes for contagion after birth are usually the following:

1. Nursing, by which a syphilitic nurse infects the child, or in which the nurse, being herself uninfected, nurses at the same time a second child which is syphilitic. Infants not only contract syphilis from members of the family and the nurses, but, as Keating says, "syphilitic infants are sources of danger to non-syphilitic members of the family, and numerous cases are seen in which the baby has infected its grandparents, nurses, and other infants." In these cases the infection is transmitted by means of patches developed about or in the infant's mouth; sometimes papules are the medium of contagion.

2. Infection may take place through the mother subsequently infected or through attendants, especially by kissing.

3. The poison may be inoculated by the midwife's or the physician's instruments or by the hands.

The question whether syphilis is ever transmitted through the milk of the mother or that of the wet-nurse is important. We have no evidence to show that this is done. Discharges from primary sores are liable to inoculate; also discharges from various secondary lesions, whether these are acquired or are hereditary. Infants suffering from syphilitic coryza or specific ulceration may inoculate the breast of a wet-nurse, but probably never that of the mother. Vaccination has been the means of introducing syphilis. *Vaccina syphilis* manifests itself not earlier than a month or six weeks after vaccination; it does so by the formation of a chancre at the seat of the vaccination (Hutchinson).

The symptoms of syphilis in early infancy will be found on page 298.

Treatment.—The treatment of infantile syphilis, like that of the adult, consists chiefly in the use of mercurials. Mucous patches may be dusted with calomel. For syphilitic coryza J. Lewis Smith advises Squibb's oleate of mercury, 2 per cent. For the general treatment the use of mercury by inunction has always given satisfactory results in the writer's experience. For inunction the oleate of mercury or the mercurial ointment should be used, the oleate in the strength of 2 per cent.; of the ointment, gr. v-x may be applied to a healthy part of the skin and be covered with a flannel binder. For

internal medication calomel may be given in doses of gr. $\frac{1}{20}$ — $\frac{1}{10}$ two or three times a day. When these mercurials produce diarrhea they may be combined with opium and aromatic powder or be omitted for a short period and again be resorted to. The child should, if possible, be nursed by its mother; if this cannot be carried out, it should be fed on artificial food. A wet-nurse should not be engaged.

Tuberculosis.—Acquired tuberculosis at the period of early infancy is very rare. Most authors, however, admit the possibility of transmission of the disease at this period of life. As producing causes are mentioned all those which lower vitality, especially syphilis and tuberculosis in the parent. Direct transmission from parent to child is possible, though perhaps not frequent. A tuberculous mother should not nurse her infant, kissing should be prohibited, and the child should sleep in a separate room (Jacobi). Experiments on the lower animals have demonstrated that tuberculosis may be transmitted by the ingestion of milk from tuberculous cows; this applies also to the use for the feeding of infants of milk thus affected that has not been boiled. Catarrhal conditions of the air-passages doubtless favor the invasion of the bacillus.

The diagnosis of tuberculosis in the very young cannot readily be made: if the disease is limited to the lungs, there is evidence of bronchial trouble. In these cases Epstein recommends passing a catheter into the larynx; this will produce a cough, during which sufficient mucus may adhere to the instrument for microscopical examination.

The treatment is chiefly prophylactic, as indicated above. When the disease is established in early infancy the same methods of treatment should be applied as those for older children.

Ophthalmia Neonatorum.—Ophthalmia of the new-born is a local affection contracted during birth. Before prophylactic measures were adopted this disease occurred in lying-in hospitals with alarming frequency. During 1868–69 in the lying-in hospital of the University of Berlin blennorrhea occurred in 5.6 per cent. of the births. In the Charité at Berlin from 12 to 14 per cent. were noted. Kilian gives the percentage at the maternity hospital of Berlin from 1826 to 1834 as being nearly 50 per cent. Since the introduction of Credé's prophylactic measures the percentage has been reduced almost to *nil*.

Etiology.—Some authorities assign different causes, such as irritating discharges of the parturient canal, whether specific or non-specific, exposure to bright light, cold, etc.—others (Unger, Bumm) pronounce all cases of ophthalmia neonatorum to be due to gonorrheal infection, the gonococcus of Neisser being alone the exciting cause. There is no doubt that the secretions of the parturient canal of the mother are usually the medium of conveying pyrogenic germs. These secretions, coming in contact with the cornea of the infant, remain fixed for some time, giving rise to a purulent conjunctivitis which manifests itself on the third or the fifth day after birth. The eye may become infected previous to birth by the amniotic fluid, or later through the infectious material on the hands of attendants, etc. (Runge). Frequently the cornea

becomes involved in this process, in which case extensive ulceration may occur resulting in loss of sight. Indirectly the disease may be transmitted from the eyes of one child thus affected to those of another; it may also be transmitted through unclean hands of attendants, unclean sponges, towels, and through water used for the bath.

Pathological Anatomy.—The changes produce excessive hyperemia and swelling of the palpebral mucosa, rendering it thick and uneven. Later there is proliferation of the epithelium, and beneath it is a diffuse infiltration of lymphoid cells. According to Bumm, the gonococci contained in the secretions invade the upper epithelial layer and find their way down to the papillary bodies, where this invasion excites marked hyperemia, producing later the profuse discharge. The cornea may remain clear, but it is liable to become invaded, showing points of ulceration; or a general infiltration may take place, resulting in an extensive destructive process.

Symptoms.—The first manifestations of this disease occur on the third or the fifth day after birth, and consist of redness and swelling of the palpebral and ocular conjunctiva. One or both eyes may be affected; sometimes the lids are glued together. The secretion is at first watery, containing flakes of fibrin; later it is purulent and very profuse. In the course of several days the secretion diminishes in quantity, and after six or eight weeks the disease assumes the form of chronic conjunctivitis.

The prognosis becomes unfavorable in cases in which the cornea is involved; 20 or 30 per cent. of the cases of blindness in children is due to corneal ulceration thus induced. Great care must be given to the cleansing of the vaginal canal in suspected cases of gonorrhea by the use of antiseptic douches previous to birth.

The treatment consists chiefly in prophylaxis. The duty of preventing the occurrence of this serious disease devolves upon every obstetrician. Immediately after birth, before the child has opened its eyes, all secretions upon and about the lids should carefully be washed away with sterilized water or with a 1 or 2 per cent. solution of boric acid.

In many hospitals Credé's method is that usually adopted—that is, after cleansing the eyes with water 1 drop of a 2 per cent. solution of nitrate of silver is dropped into each eye. At the first manifestation of the disease active measures should be adopted. Usually but one eye is affected; in that case the other eye should be protected by placing over it absorbent cotton, covering the cotton with a watch-crystal, and sealing this with collodion or with adhesive plaster; but the eye should be examined daily to be assured of its healthy state.

When the disease has been developed two forms are distinguished, the mild and the severe, each having two stages, the congestive and the purulent. In the mild form the treatment in the first stage consists of the application of cold compresses. In the second stage the eye is cleansed every two hours with a saturated solution of boric acid, and a $\frac{1}{2}$ per cent. solution of nitrate of silver is applied to the cul-de-sac.

In the severe form cold compresses are applied; the eye is cleansed by a solution of bichlorid of mercury (1 : 8000) and a saturated boric-acid solution used alternately every hour. As soon as suppuration is established the solution of nitrate of silver is applied to the cul-de-sac of the cornea. While making these applications to the upper everted lid the cornea must be protected by the lower lid, and *vice versa* (Bettman). It is best to begin with a 2 per cent. solution, but should this fail to control the suppurative process a 4 per cent. solution may be employed, and should immediately be neutralized by a solution of salt. Should an ulcer of the cornea form, it is the practice of ophthalmologists to employ cautiously weak solutions of eserin ($\frac{1}{4}$ to $\frac{1}{2}$ grain to the ounce). When iritis or a central ulceration of the cornea is present atropin (gr. ij-iv to the ounce) is preferred. The first signs of poisoning by this drug should carefully be observed. When the swelling subsides and the discharge decreases, and especially when there is corneal haze, hot applications may be made. For the treatment of further complications the reader is referred to works on ophthalmology.

La Grippe.*—The testimony that very young infants may be subject to this disease is increasing. Dr. Townsend of Boston has placed on record a case where the mother had an attack of influenza either before or shortly after her confinement, and the child very soon after its birth began to sneeze, had rapid respiration, followed by a temperature of 104°, and passed through an attack of *la grippe*. It is fair to presume that this child was infected before or within a short time after its birth. The *British Journal* narrates another case in which the infant died on the third day, having had a high temperature, rapid respiration, and pulmonary catarrh. The mother of this child had influenza four days after her delivery.

The following case† was observed in 1890: A healthy woman was delivered of a healthy child; both mother and child appeared perfectly well during the first week, after which the husband was taken with *la grippe* of the gastrointestinal form. Two days later the wife was taken, and on the following day the infant manifested characteristic symptoms of the disease—restlessness, rise of temperature, icterus, loss of appetite, and diarrhea. The stools were frequent and of a putrescent odor. In all three members of the family the intestinal catarrh was accompanied by catarrh of the respiratory tract. In the mother this attack was followed by prolonged and great nervous exhaustion, for which no other cause could be assigned.

Diagnosis and Treatment.—It is difficult to diagnosticate *la grippe* in very young patients, but when the infection is present in the house and the parents or the nurse are under its influence, if an infant within a very few hours after birth presents the usual symptoms of fever, exhaustion, and great prostration associated with the involvement of one of the three systems that is usually selected by this infection, the disease is most probably due to the poison of

* Most of the material for this subject is taken from Dr. Earle's article, "Manifestations of La Grippe in Children," *Archives of Pediatrics*, 1892.—M. J. Mergler.

† The case described occurred in my own practice, but has never been reported.—M. J. M.

influenza. In treating these cases we should be guided by the same principles as for adults—that is, disinfecting the intestinal tract, supporting the strength, and meeting complications.

C. INFECTION OF THE DIGESTIVE AND RESPIRATORY TRACTS.—Septic Gastro-intestinal Catarrh.—Infection through the mucous membrane of the mouth is characterized by a catarrhal state involving the intestinal tract. Epstein described the different degrees of invasion as septic catarrh, septic croup, and septic diphtheritis. This form of catarrh differs from the ordinary dyspeptic form in that it occurs in nursing children, and that it is more liable to occur in winter than in summer. This difference is ascribed to the fact that during the winter ventilation is not so good as during warm weather.

Thrush (*spore* or *soor*) is a local disease of the mucous membrane of the mouth due to the growth of a vegetable parasite, often designated *oidium albicans*. Although the parasitic character of the disease has long been known, no definite botanical place has been assigned to the fungus. The presence of soor is very common among infants, and it occasionally occurs in the very young. It is of frequent occurrence in foundling homes. Artificial food and impaired nutrition favor its development. The disease manifests itself in the formation of white points resembling curdled milk; these patches coalesce and adhere to the mucosa, which becomes very tender. Nursing becomes difficult, and diarrhea often results from the disordered state of nutrition.

Diagnosis and Treatment.—The diagnosis is based on the occurrence of the white patches above described. In doubtful cases a microscopical examination will reveal the nature of the disease. The treatment consists in removal of the patches, cleansing the mucosa, and supporting the strength of the patient. After each nursing the little patient's mouth should be washed carefully with a mild antiseptic fluid—boric acid, 5 per cent., or chlorate of potash, 2 per cent. The application should be made very gently to prevent unnecessary desquamation of the mucosa. If the child nurses from the breast, the nipples should be washed off carefully with a similar solution before and after nursing.

Gonorrheal infection will also produce an acute catarrhal inflammation of the mouth. The treatment is similar to that of thrush.

Stomatitis Aphthosa.—We are indebted to Bohn for giving this term a definite meaning, as there have been a number of varied pathological conditions of the mouth that were termed "aphthæ." Bohn limits the term to a pathological lesion of the mucous membrane of the mouth, which lesion is characterized by the formation of distinct discolored spots from which the epithelium denudes, leaving shallow ulcers. As to the anatomical nature of these spots, there is still considerable discussion, some holding that it is a true vesicular eruption, others that it is due to a solid exudation between the cutis and the epithelium.

The etiology is not settled. Although the disease is more likely to occur after the tenth month, it may occur in the young. Aphthæ are found in the mouths of many children in asylums, maternity hospitals, etc. Sometimes they seem to be conveyed from child to child by wet-nurses whom the children

have in common, but the bacterial origin of the disease has not been demonstrated. This eruption frequently occurs in poorly-nourished children.

The treatment consists of antiseptic measures as regards nursing-bottles, care of the breast of the wet-nurses, etc. The child's mouth should be washed frequently with a solution of boric acid, 3 per cent.; the ulcerated portions may be touched with a solution of nitrate of silver.

Diphtheria.—Literature does not cite many cases of diphtheria in the new-born; characteristic cases, however, have been observed. J. Lewis Smith believes the new-born to be susceptible to this infection, and he reports several cases. In two of these cases umbilical phlegmon was also present. Diphtheria in the mother does not, as a rule, greatly endanger the child (Müller), although cases are on record in which the disease was transmitted directly from mother to child. The treatment is the same as that in older children.

Rhinitis.—The occurrence of persistent coryza in very young infants is frequently due to hereditary syphilis. This symptom usually does not manifest itself before the second month, but it may occur earlier. Non-syphilitic suppurative rhinitis may occur during the first few days of life, and may be due to infection from the discharges in the parturient canal.

The treatment of the simple catarrhal and suppurative rhinitis consists in cleansing the nasal passage with mild disinfecting solutions, as in older children; a small syringe or medicine-dropper may be used for this purpose.

5. GENERAL AND UNCLASSIFIED DISEASES.

Sclerema neonatorum is a disease consisting of an induration of the skin and the subcutaneous cellular tissues, associated with rapid lowering of the body-temperature. The disease is hardly known outside of foundling homes and maternity hospitals.

Etiology.—The etiology is imperfectly understood. Baginsky suggests infectious agents. It has also been asserted that the disease is due to an excess in the tissues of the infant of palmytic acid, which solidifies at the low temperature accompanying the disease. There seems to be some relation between imperfect development of the fetal heart and sclerema (Demme). It occurs in cases of premature birth and in infants who are poorly nourished.

Symptoms.—The premonitory symptoms are slight: the skin is first red and then has a mottled appearance; these changes manifest themselves first upon the calves of the legs, on the dorsum of the feet, then upward, involving the thighs, the abdomen, the upper extremities, the face, and the head. The rectal temperature falls from the normal to 86° or even 83° F.; the pulse is weak, the excretions and secretions sluggish, and the edema which now forms renders the skin pale and hard; gradually the whole body becomes cold and rigid, and eventually sensibility is lost. Death occurs without convulsions. Occasionally the patient recovers; in these cases the infiltration subsides, the dorsum and soles of the feet being longest affected.

Pathological Anatomy.—The portions of the skin affected are either yel-

lowish-white or present a mottled, bluish appearance. Incision through the infiltrated skin is followed by discharge of a yellowish or a reddish fluid from the cellular tissue. This fluid usually coagulates upon exposure to the air. The brain is edematous, rarely showing hemorrhagic spots. In the lungs there is usually atelectasis, occasionally evidence of lobar pneumonia. In some of the other organs there frequently are ecchymoses. This disease may be complicated by pneumonia, septic disease of the umbilicus, pemphigus, and syphilis.

Diagnosis and Prognosis.—The diagnosis is based chiefly on the infiltration of the skin and the falling of temperature. This edematous form of sclerema must be differentiated from the adipose form in older children; also from the usual forms of edema that are characterized by "pitting" on pressure. The prognosis is unfavorable.

Treatment.—The treatment consists chiefly in the application of artificial heat and massage and the administration of stimulants. Artificial heat is supplied both dry and by means of the bath. An incubator will be of service to maintain the temperature. Massage is given with the view to improving the circulation and favoring the absorption of the serum.

A. Money reports a case of sclerema neonatorum successfully treated by friction over the indurated areas with sweet oil, together with daily inunction of blue ointment into the skin of the abdomen. This author excludes any evidence of syphilis in this case. Alfred Barrs also reports a case in which the induration entirely disappeared in two months on mercurial treatment. One-half grain of gray powder was administered night and morning. Stimulants must be administered frequently—whiskey, 3 to 5 drops every half hour. Aqua camphor and tincture of digitalis may be added with advantage. In all cases special care must be given to favor the nutrition of the child, for which purpose *garage* will be of service.

Hemorrhagic Diathesis.—It will be noticed in a few cases that an infant exhibits within a short time after birth a tendency to bleed, at first perhaps from the umbilical region, then from mucous membranes of the different openings of the body, from the conjunctivæ, and finally from the integument. In other cases this tendency will be noticed upon a slight local injury which under ordinary circumstances would be insignificant.

Etiology.—Our knowledge in regard to the cause of the disease is rather indefinite, but in a majority of cases it may be traced to some constitutional or septic influence. The symptoms have already been stated above. Anemia naturally results.

Diagnosis.—If there is a family history of a tendency to hemorrhage, if the hemorrhage is persistent, producing prostration, anemia, and collapse, the diagnosis is easily made.

Prognosis.—Except in very young infants the patient rarely dies during the first hemorrhage. The longer a "bleeder" survives, the greater is his chance of outliving the tendency to bleed. In the very young when there are symptoms which suggest continuous bleeding, anemia, and a tendency to collapse, the prognosis is very bad.

Pathology.—Nothing except the anemic condition is found in the viscera upon post-mortem examination. An unusual thinness of the blood-vessels has been noticed.

Treatment.—The principal indications are to check the hemorrhage and to support the strength of the child: to this end the extremities of the child should be kept warm, and if ice is used as a local hemostatic, it should cover but a small surface, for the tendency to reduced temperature and collapse is very great. Among the remedies which promise the best results are ergot, preparations of iron, gallic acid, and aromatic sulphuric acid.

Hemorrhage from the Female Genital Organs.—It happens, very rarely, that there is a slight oozing of blood from the vagina during the first few days of the infant's life.

Etiology.—In all probability this slight hemorrhage is due to the congested condition of the pelvic organs. The sudden cessation of the flow of blood through the umbilical arteries may also contribute to this result. It is claimed by some authors that menstruation may occur in the new-born. Cullingworth collected 32 cases of menstruation in young infants.

Symptoms and Treatment.—The *symptoms* are simply a slight oozing of blood, which can be differentiated by an examination of the parts. A red stain, often produced during the first days of infancy by the escape of uric acid or urates, must not be mistaken for this form of hemorrhage. If the hemorrhage is slight and unassociated with the hemorrhagic diathesis, no *treatment* will be required.

Gastro-intestinal Hemorrhage (Melena).—By this term is meant an escape of a variable amount of blood, usually from the bowels, but occasionally vomited, during the first few days of infant life. The amount of blood lost and the symptoms that follow in this disease range all the way from a slight and harmless hemorrhage with no general symptoms to a loss of blood so great that the death of the child is imminent. This form has been spoken of by some authorities as the "black disease," and by others as "melena." We recognize three classes or varieties of gastro-intestinal hemorrhage:

First, the unimportant class due to very slight congestion or abrasion in the integrity of the lower bowel. Thrombosis of the umbilical blood-vessels has been thought to increase the congested and hyperemic condition of the gastro-intestinal canal, which condition always exists immediately after birth. Asphyxia is another predisposing cause. Blood in considerable quantities may flow from a fissured or excoriated nipple of the mother and be swallowed by the nursing child, and make its appearance either as moderately bright, fresh blood in the vomited material or very much changed in color and consistence if it is mixed with excreted matter from the bowel. This discharge must not be mistaken for hemorrhage coming from the child.

The second class is somewhat more grave: it is caused by deep erosions or ulceration in the gastro-intestinal tract or by the perforating round ulcer of the stomach.

The third variety is caused by constitutional diseases present in the new-

born, such as hemorrhagic diathesis, syphilis, various forms of sepsis, the hemorrhagic eruptive diseases, and fatty degenerations.

The second and third classes constitute melena proper, which is rare. According to Buhl and Hecker, 8 cases occur in 4000 births; according to Spiegelberg, 2 in 5000; according to Genrich, 1 in 2800 (Unger). The unimportant or simple variety of hemorrhage occurs somewhat more frequently.

Symptoms.—The blood usually begins to flow about the second day; sometimes it is vomited, at other times it comes from the bowel. If the blood is vomited, its color may not perceptibly be changed, but if it is discharged from the bowel, it is usually dark, mixed with meconium, which is apparently more profuse than usual. In the course of twenty-four hours, if the hemorrhage continues, the child begins to fail and becomes pale, cold, and indifferent; the pulse is small and rapid; respiration is very frequent; the child is in collapse, and death occurs in a few hours.

Prognosis.—The prognosis depends largely upon the etiology. In the first variety of gastro-intestinal vomiting the prognosis is good; in the second and third varieties it is always grave. The mortality of true melena, as stated by different authors, is from 30 to 70 per cent. The prognosis becomes especially grave if the hemorrhage lasts more than forty-eight hours.

Diagnosis.—Look carefully for local causes, and then for some constitutional defect. Slight hemorrhage with trismus should cause one to look for intussusception. If the blood is vomited and fresh and the child has no symptoms of depression, it may have come from the mother's nipple, from the child's tongue, or from some part of the upper digestive tract or respiratory apparatus. If it is from the bowel, and evidences of cyanosis or jaundice or depression soon follow, in all probability some general disease is the cause.

The pathology varies with the cause. In true melena the tissues are usually pale and anemic. Ecchymoses upon the different membranes, and occasionally eroded blood-vessels, may be seen, or there may be found evidences of the severe general diseases referred to on the previous page.

Treatment.—About the same line of treatment is indicated here as that for the hemorrhagic diathesis. In the first variety of hemorrhage the treatment consists in giving attention to the existing local cause. In true melena, if mild, the internal use of astringents may be of value; in addition to this, the treatment is directed to the supposed cause, while every effort is made to support the strength of the child. In severe cases all therapeutic measures are powerless.

Colic and Diarrhea.—*Colic* is a very frequent cause of suffering in infants; even during the first days of life intestinal colic will be brought about by an irritation of the sensory nerves of the alimentary canal: this irritation may be due either to the abnormal properties of the digestive products or to imperfect processes of fermentation, leading to excessive formation of intestinal gas; also to the irritation produced by accumulation of fecal matter and to the delayed expulsion of meconium. In other words, the irritation may be either chemical or mechanical. In both instances the

first cause is usually due to improper food. In the young, reflexes are especially easily excited. An infant nursed at the breast will suffer from imperfect digestion and from abnormal formation of gas if the breast-milk contains a considerable amount of colostrum, and also if nursed by a wet-nurse whose milk is unsuitable because of disparity in age between her own and the child she is nursing. All artificial foods, especially the amylaceous group, predispose to flatulence. Constipation, whether due to imperfect diet or to some stenosis in the alimentary tract, will give rise to distention and irritation, producing severe forms of colic.

The symptoms of colic are sudden attacks of pain, manifested by the infant refusing to nurse, by its restlessness, and by contraction of the limbs and of the abdominal muscles. After the expulsion of gas the symptoms will disappear as suddenly as they came.

The treatment during the attack consists of the application of dry heat and gentle friction in the course of the colon. Should the attack be severe, a warm bath will afford the greatest relief. The introduction of a soft catheter into the rectum will favor expulsion of the gas, and may be followed by an enema of oil or of warm water.

The food must carefully be investigated, and if found at fault it must be changed for one more suitable. In acidity of the vomited matter or of the stools small doses of calomel combined with alkalies will be of benefit; aromatic teas will relieve by favoring the expulsion of gas. Among medicines usually found efficient are grain doses of pepsin, 2 to 5 drops of gin or whiskey in hot water, drachm doses of hot soda-mint, or the milk of asafetida administered by the mouth (10 to 20 drops) or by the bowel. The habitual use of paregoric for this trouble is to be condemned.

Diarrhea.—During the first few days after the birth the stools of the infant are a dark brown or greenish mass called "meconium." This substance is very tenacious, consisting of fatty matters, epithelial cells, biliary pigments, and cholesterin. It is really an accumulation in the small intestines of bile which collected during fetal life. After the third day the meconium has passed, and is substituted by yellowish, semi-liquid stools. Under normal conditions the new-born infant has three or four stools a day. In infants, on account of the pasty condition of the intestinal matter, more or less excrementitious material will collect in the rectum, which fact explains in some degree the number of daily evacuations from the bowel of infants in health. What, then, constitutes diarrhea in infants? This question can only be decided by observing the character of the passages and noting the growth of the child. One evacuation each day in some cases may be sufficient, but frequently where this is the habit some of the deleterious results of constipation will be observed. Nevertheless, we have frequently noted three or four movements each day, and have found by actual weight of the child a normal increase from week to week, with every indication of good development. From one to four passages each day, then, would be regarded as normal. Deviations from the normal number occur, such as evacuation every time the napkin is changed. Idiopathic diar-

rhea may occur during the first week. It is usually due to bad hygienic surroundings, to foul air, and to improper food. Sudden changes of temperature are very apt to produce diarrhea.

The treatment of diarrhea, like that of colic, is based on the same principles as that for the same derangement in older children, the selection of proper food being the principal element of treatment. Small doses of calomel (gr. $\frac{1}{20}$ to gr. $\frac{1}{4}$) two or three times a day will correct the fermentation. If this drug does not correct the trouble, from 1 to 3 grains of subnitrate of bismuth and 2 to 4 drops of aromatic sulphuric acid may be added to check too frequent stools.

Constipation.—Constipation is very common even in the very young; it may be a symptom of various pathological conditions. In children the intestine is relatively longer and its calibre smaller than in adults; the walls are thinner and weaker. The ascending and transverse colon is shorter, and possibly flexures are formed because of pressure from above by the liver, which is relatively larger in a child; also by the relatively contracted condition of the pelvis. These anatomical peculiarities give less space to the intestinal tract, and in some cases they represent etiological factors in causing constipation. The peristaltic movement in babies is slight because of imperfectly developed muscular structure. As the child develops peristaltic action and muscular tone are increased. Another anatomical peculiarity in the lower bowel is the deep cul-de-sac which the sigmoid flexure forms before it joins the rectum. This pouch predisposes to fecal accumulations. Gerhardt denies the existence of so marked a curve in the sigmoid flexure.

In the healthy child the mother's milk is mostly absorbed and assimilated, leaving but a small amount of residue; the amount of material evacuated has some relation to the amount taken into the system. The albumin of the milk is nearly all digested in the stomach and bowels of the child, and from this very process we have a physiological cause for constipation, fecal matter existing in such small amount that intestinal peristalsis is not excited. Habitual constipation in the mother may be a predisposing cause of constipation in the infant. Other causes are deficient intestinal secretion, excessive perspiration, medicines, herniæ, intestinal obstruction, congenital malformations, chronic peritonitis. Constipation occurs also in meningitis, in myelitis, in hydrocephalus, and in microcephalic conditions and other diseases of the cerebro-spinal system.

What has been said above under the head of *Diarrhea* concerning the number of normal passages in an infant applies also to constipation. From one to four passages a day may be considered normal, providing the child does not suffer. A steady increase in the weight and the general good condition of nutrition will aid one to decide whether the number of passages is sufficient. Constipation is undoubtedly more frequent in adults than in children. In all probability, what are called "family peculiarities" are due more to the neglect of the proper attention to the wants and habits of children.

Treatment.—In the nursling the use of drugs should usually be discarded. After excluding congenital defects, we should look to the mother for the cause;

also to the child's diet. Artificial foods, including condensed milk, in many instances produce diarrhea, but in other cases they give rise to constipation; any food which is absorbed quickly, leaving little or no residue, will produce this condition. To obviate this effect, if water has been used as the diluent, oatmeal-water should be substituted. The effect of local stimulants, such as introducing soap or glycerin suppositories into the rectum, should be tried. Whenever the colon is blocked up it must be cleared by the use of an enema. Glycerin may be administered in the form of an enema (30 to 60 drops, diluted with a little water). Large injections of fluid (more than 2 to 4 ounces) should be avoided; they produce over-distention and paresis.

Intestinal Obstruction.—Most cases of intestinal obstruction in the young infant are due to congenital malformations, either from arrest of development or from the effects of fetal peritonitis. Volvulus or intussusception may cause obstruction.

The symptoms of obstruction are constipation, colic, intense pain, often distention of the bowel. There is no escape of flatus; sometimes there is a discharge from the rectum of mucus and blood. In volvulus the symptoms usually occur suddenly.

The diagnosis is not always easy. In cases of complete obstruction the child does not pass meconium. Soon after being put to the breast it begins to vomit, first the contents of the stomach, then bile, later meconium. The abdomen soon becomes distended. Death occurs in a few hours or days. In some cases the anus is absent. If the external opening is present, a malformation of the rectum is apt to be overlooked and the case diagnosed as simple constipation. In these cases purgatives only increase the difficulty. The child suffers much pain, cries almost constantly, the abdomen is greatly distended, vomiting and symptoms of collapse appear, and death from exhaustion finally occurs. If digital examination is made, the finger will pass but a short distance. If there be only a membranous septum, the bulging of the gut from above can distinctly be felt. When the anus is absent and the rectum ends just above it (which is the commonest condition), bulging of the lower end of the rectum may be felt, but if the rectum ends higher up, this will not be observed.

Treatment.—Many infants with obstruction of the bowel are either stillborn or they live but a short time. Surgical measures must be resorted to soon after birth. When there is only a thin septum between the rectum and the gut, a crucial incision and dilatation with the finger will be all that is required. The mucous membrane should be stitched to the skin. If the separation between the rectum and the surface is greater, the bulging of the distended gut must carefully be looked for, and if it is found incision should be made in front of the coccyx and be carried down until the bowel is reached. The bowel should then be opened, drawn down, and stitched to the skin. If the gut cannot be found below by dissection, then an operation from above should be undertaken. Littre's operation of opening the colon through the groin, or Amussat's lumbar operation, must be performed. The opening of the peritoneal

cavity should be attended with the usual aseptic precautions. The steps in the operation are practically the same as those in the case of an adult.

Lamphear reports a case of absence of the upper rectum in which the following operation was performed, apparently with success: "An incision was made through the sphincter to the coccyx, and dissection was made through the connective tissue to near the promontory of the sacrum. A small sound was inserted into the bladder as a guide. After dissecting upward for about an inch and a half, the peritoneum was reached. This was cut into, the sigmoid flexure of the colon easily pulled down and stitched to the upper end of the rectum, an opening three-quarters of an inch being made in the side of the bowel, with the discharge of an immense amount of feces. There has been no fever and no peritonitis, and the child is well and growing nicely."

In cases where fecal matter has been passed by the rectum and there are suddenly-developed symptoms of obstruction, volvulus is likely to be the cause. If the administration of laxatives (castor oil) and enemas has failed, then it is necessary to resort to abdominal section both for diagnosis and for relief.

Sometimes during infancy (most frequently between the ages of four and six months) a portion of an intestine passes into another.

Inguinal and Umbilical Hernia.—In infants the inguinal canal is straight and short, and in delicate male children a hernial protrusion including a loop of intestine is not uncommon. Most of these cases may be cured by the wearing by the child of a properly-fitting truss for several months or years. Umbilical hernia may be acquired in poorly-developed children when there is a large cord; the hernial sac will sometimes contain small intestine and peritoneum. A compress or a disk of metal or hard rubber larger than the protrusion should be made, and held in position by means of a bandage; knitted bandages are most comfortable and useful.

Peritoneal abscess rarely occurs in early infancy. One case is reported in which the abscess was due to caseous mesenteric glands (Ashby and Wright).

Disturbances of the Urinary Organs.—Infants frequently pass with the urine considerable uric acid, which forms a visible deposit on the napkin. This passage of uric acid may be unaccompanied by any discomfort; again, it may cause disturbance in micturition, or even convulsive seizures and pain. The *treatment* consists in administering small doses of citrate of potash and sweet spirits of nitre.

The malformations described on page 303 are also accompanied by various disturbances of the urinary function. Opening of the rectum into the urethra or the bladder is evidenced by the passing of fluid feces and gas through the urethra, or in the female it may pass through the vestibule. Later, vesical irritation caused by the decomposing urine may take place. The health of the patient is not always interfered with. Contraction of the urethra may give rise to incontinence or retention of urine. In these cases catheterization will give temporary relief. Dilatation may become necessary.

Phimosis, or elongation and contraction of the prepuce, often gives rise to nervous disturbance and to painful micturition, or even to convulsions.

Treatment for Phimosis.—If phimosis occurs only in a slight degree, daily retraction and cleanliness for a week or two usually overcome the difficulty. Even when the prepuce is very tight and adherent to the glans penis, it is usually sufficient immediately or soon after birth to separate the adherent surfaces with the flat end of a probe, followed by thorough dilatation of the prepuce with dressing-forceps. The foreskin should thereafter daily be retracted, cleansed, and a film of cotton covered with borated vaselin should be laid over the glans penis before allowing the prepuce to recover the glans. If the phimosis gives rise to secondary derangements, such as irritation, incontinence, or retention of urine, hernia, prolapse of the rectum, and more severe reflex nervous troubles, circumcision should be performed early should the above-mentioned plan of treatment fail.

Hypospadias, epispadias, and extroversion of the bladder will cause incontinence of urine and excoriation. Operations for these conditions are the only means of relief; they are usually delayed until after the child is one year old, and are not always successful.

6. HYGIENE AND THERAPEUTICS SOON AFTER BIRTH.

1. HYGIENE.—*Care immediately after Birth.*—The air-passages should be cleared of mucus by inverting the child and brushing away the mucus with the finger. When the infant has cried lustily and the cord has been severed, the little one should be wrapped in a warm flannel receiving-blanket. The eyes and navel should immediately be cleansed with sterilized water and be washed by a 3 per cent. solution of boric acid; after that the nurse may proceed at once to cleanse its body. For this purpose the bath is not always advisable. Very feeble children are easily chilled, and in these the water-bath at first is to be avoided; instead of the bath the body may be anointed with olive oil or with plain vaselin, which is removed with absorbent cotton. Vigorous rubbing of the skin should be prohibited. The room should be warm. The child should be bathed every day with oil or with water. The dressing of the cord has been fully described on page 828. Before clothing the child a careful examination must be made to detect any existing malformation or defect, and finally the cord must be examined to see that there is no bleeding.

From the first the infant is to have its own crib, which may be placed near the mother's bed or in the adjoining room if a special nurse can be provided. This room should be aired regularly night and morning. During the first few days laying the baby on its right side will favor closure of the foramen ovale.

Food.—As soon as the baby has been cleansed and the mother has been cared for and rested, the child should be placed to the mother's breast; this being done both to satisfy the natural instinct of the child and for the benefit derived by the mother from the reflex contraction produced in the uterus. The first secretions of the breast will usually supply sufficient nourishment, and their laxative quality is beneficial to the child. In the course of from

thirty-six to seventy hours the secretion of milk should be established. It is essential that from the beginning the child should acquire regular habits of feeding, and for this reason it should be applied to the breast at regular intervals—for the first month every two hours during the day and two or three times during the night. Before placing the child to the breast the nipple should be washed with sterilized water, and again after nursing. The importance of giving proper attention to feeding babies cannot be over-estimated.

Infant mortality is very great; up to the fifth year about 25 per cent. of babies die. One author shows that out of 1940 deaths of infants, only sixty-one were nursing at the breast.

The rapid development of infants involves rapid tissue-change and necessitates constant and sufficient supply to all the structures. Well-fed babies are usually quiet and give comparatively little trouble, and they are usually exempt from disease; while poorly-nourished babies are fretful and are particularly liable to have convulsions.

No artificial food can take the place of the mother's milk; nursing infants usually thrive well; but, unfortunately, many mothers, especially in the favored class of society, are unable to provide this milk. Again, many who can are unwilling to do so. A wet-nurse is the best substitute next to that of properly prepared cow's milk. Mixed food is likely to cause diarrhea. The details of artificial feeding have been discussed on page 668.

2. THERAPEUTICS AND DOSAGE.—The following are some of the remedies most commonly required in early infancy:

A. External Remedies.—Antiseptics.—The stronger remedies in this group must be used with caution, as infants are very susceptible to their toxic effects; this is especially true of iodoform and of carbolic acid. Salicylic acid and boric acid are to be preferred. The former may be diluted with starch (1:3 or 1:5). Bichlorid of mercury is used in solution of 1:5000 to 1:10,000.

Protectives.—Boric acid and lycopodium or borated talcum powder constitute an excellent baby powder. If there is much chafing, subnitrate of bismuth and starch (1:5) may be substituted. Simple cerate is also efficient for chafing. Oiled silk is used to protect the skin from cold, to favor perspiration, and as a protective in swelling.

Astringents.—The formulæ of salicylic acid and boric acid, referred to above, are excellent astringents.

Counter-irritants in early infancy must be used with care. Babies do not bear blisters well. In colic a spice poultice is a good counter-irritant.

Heat and Cold.—Care must be observed in applying heat and cold. A warm bath is a good nerve-sedative and often reduces temperature. Warm fomentations may be used on the chest and the abdomen, but they are often dangerous when applied to the head. Ice applied to the head must be used with caution.

B. Internal Remedies.—Nutrients and Tonics.—When additional nutrition is required, peptonoids, beef extracts, and cod-liver oil are beneficial;

the latter may be used by inunction. Among tonics, the syrup of the iodid of iron may be given in drop doses, two or three times a day.

Digestives, antiferments, and antacids are usually required only by babies who are fed artificially. Administering these agents in hot water adds to their efficiency. Pepsin given in grain doses will aid digestion. Aromatics, such as peppermint and anise, are given in the form of an infusion. Salicylate of bismuth, calcined magnesia, and charcoal are also efficient antacids. Calomel, $\frac{1}{12}$ to $\frac{1}{4}$ of a grain, is very efficient in fermentation of food.

Laxatives.—Constipation usually depends on dietetic errors which should be corrected before drugs are given. The addition of sodium, of sugar, or of both, to the food will often correct the trouble. Among drugs, castor oil, from 15 to 30 drops, is the best laxative. Calcined magnesia, from 8 to 10 grains, is excellent where there is acidity or flatulence. For chronic constipation the fluid extract of cascara sagrada (5 to 30 drops) or compound licorice powder ($\frac{1}{4}$ teaspoonful) may be used occasionally.

Stimulants are especially indicated in the prematurely born and in any condition in which the circulation is impaired and the vitality is low. Among alcoholic stimulants whiskey is the best: 1, 2, or 3 drops may be given every hour. Alcohol is especially indicated in septic diseases, in which it is borne in much larger doses. Carbonate of ammonia, $\frac{1}{2}$ to 1 grain, and tincture of digitalis, $\frac{1}{2}$ minim, every hour, are excellent cardiac stimulants.

Antipyretics are not often indicated; when the temperature is high, it is best to reduce it by the use of the bath.

Antispasmodics in early infancy are required usually for colic, in which case the antiferments may be given; in addition the milk of asafetida in from 15- to 30-drop doses is excellent.

Nerve-sedatives are not often required, and should, as a rule, be avoided. The irritation and pain may usually be relieved by removing the cause; this applies especially to faulty diet and its sequences. When opiates are unavoidable, paregoric may be given in from 2- to 5-drop doses.

Alteratives are especially indicated in hereditary syphilitic disease, and in this case they should be continued for a long time. If the baby nurses from its mother, both should be under treatment. Mercurials are well borne in early infancy. Calomel $\frac{1}{2}$ grain, or gray powder $\frac{1}{2}$ grain, may be given by the mouth, or the oleate of mercury may be used by inunction.

Mercurial ointment, $\frac{1}{2}$ drachm, mixed with equal parts of vaselin if applied to the body of the child from axilla to pubes, and covered by an armless, snug-fitting flannel jacket, makes a good permanent medicating medium. This binder may be retained day and night until it becomes soiled or worn, when it should be replaced by a new one similarly medicated. For onychia, bullæ, or fissures due to syphilis, the protiodid of mercury may be used.

Diuretics.—Before administering a diuretic a careful examination should be made to exclude the existence of congenital obstruction. Diuretics are occasionally required during the first days, when the urine is deficient and where there is much deposit of urates or of uric acid. Sweet spirits of nitre,

5 drops, combined with citrate of potash, $\frac{1}{4}$ to $\frac{1}{2}$ grain, may be given two or three times a day.

Hemostatics are required with the hemorrhagic diathesis and in sepsis, melena, etc. Fluid extract of ergot, from 1 to 3 drops, gallic acid, 1 to 2 grains, and cracked ice are the most useful; but ice must be used with caution when the vitality is low.

7. PREMATURE INFANTS.

By a "premature infant" is meant one that is born between the period of viability and the natural end of pregnancy, whether the interruption of pregnancy be spontaneous or be induced. The exact period of viability cannot be fixed upon accurately in any given case, for the period may vary within relatively wide limits. In this respect much depends upon the nourishment of the fetus prior to its birth, the condition of the mother during pregnancy, the conditions necessitating or leading up to the interruption of pregnancy, the duration of, and complications and difficulties attendant upon, labor, as well as upon the nature of the surroundings and the ability of those interested properly to care for the child. It has been customary to fix the period of viability at twenty-eight weeks. As a number of premature infants of twenty-four weeks have successfully been raised, the suggestion that any child that breathes at birth be treated as viable should be adopted in place of any fixed rule based upon the age of the fetus or upon its size.

To preserve the life of the premature infant to a time corresponding to what would have been the normal completion of pregnancy it is important that there be observed certain essentials in its care and management. This necessitates that we pay especial attention to—

First, the maintenance of the bodily temperature.

Second, the prevention of exhaustion.

Third, the administration of the proper amount and kind of nourishment.

The nearer to the end of full term the child is born, other things being equal, the more favorable are the chances for preserving its life, under proper care, to what would be the natural time. If it has been thus preserved and it has increased sufficiently in weight and strength, its chances for life then are the same as that of a child born at full term.

The Maintenance of the Bodily Temperature.—The vital organs of the premature infant have not developed sufficiently to maintain a uniform body-heat independently of other means. During intra-uterine life the fetus is surrounded by a fluid of a uniform temperature, and the heat of the blood is regulated by means of the placental circulation. We can best imitate these methods of nature by surrounding the child's body with a suitable non-conducting material kept constantly at an even temperature, and by furnishing to the child a plentiful supply of pure air that is also of a certain definite and uniform temperature.

This condition, the maintenance of the bodily temperature, is best met by the use of an incubator or *couveruse*. There are several patterns of incubators,

notably those of Tarnier, of Auvard (Figs. 444, 445), and of Credé, which have been used with especial success in the maternity hospitals of France and Germany. They are more or less complicated and expensive structures, and, while of the greatest utility in hospitals and among the wealthy, they would often be impracticable in private practice, especially among the poor and in towns remote from a metropolis. A modified Auvard incubator can be made by any carpenter at a trifling expense, and will give satisfaction. The accompanying illustrations explain its mechanism (Figs. 446-448). Credé's incubator and modification of it consist essentially of a double-walled copper tub. The space between the walls

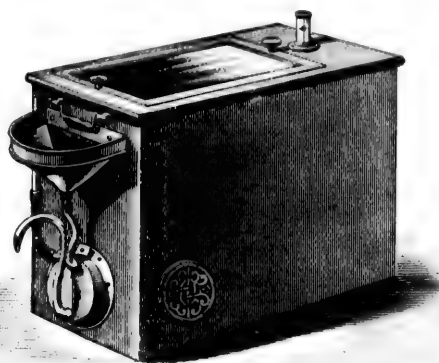


FIG. 444.—Auvard incubator or couveuse.

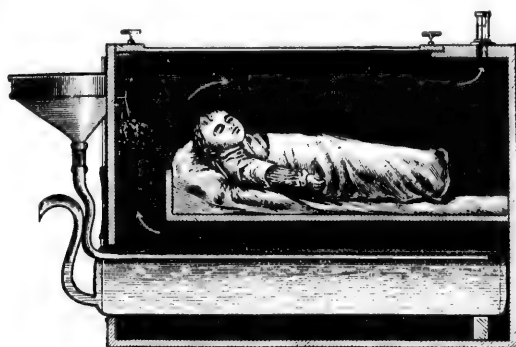


FIG. 445.—Interior view of the Auvard incubator (Fig. 444).

is filled every four hours with water at a temperature of 122° F. The tub is half filled with cotton-wool, upon which the child is placed, undressed, with absorbent cotton about its genitals. The tub is then filled with cotton-wool, with the exception of a space for the child's face. An extemporized incubator may be made in any home with easily procured materials that will answer the purpose of the more elaborate manufactured article very well. A large-sized market basket, a small-sized clothes basket, or an ordinary wooden box is first lined with heavy wrapping paper, and is then thoroughly padded with blankets or cotton batting or both. Half of the basket or the box is then filled with some soft, non-conducting material, such as cotton-wool or cotton batting. Hot-water bottles or hot-water bags are to be so arranged about the sides of this receptacle that one or more may be removed or exchanged without exposing or in any way disturbing the child. The child, having been thoroughly anointed with warm sweet oil, is placed in this receptacle undressed, with an absorbent pad arranged

Credé's incubator and modification of it consist essentially of a double-walled copper tub. The space between the walls is filled every four hours with water at a temperature of 122° F. The tub is half filled with cotton-wool, upon which the child is placed, undressed, with absorbent cotton about its genitals. The tub is then filled with cotton-wool, with the exception of a space for the child's face. An extemporized incubator may be made in any

for the collection of feces and urine. The incubator is then filled with cotton-wool or cotton batting, the child, with the exception of its head, being completely covered. If

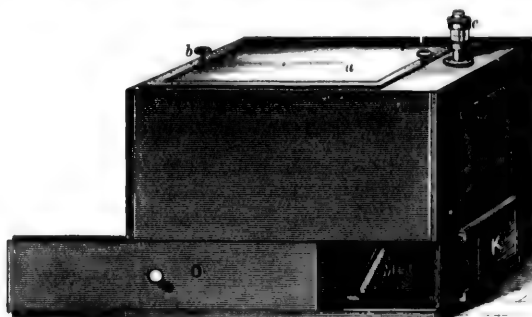


FIG. 446.—Modified Auvar incubator: *a*, glass plate of the movable lid *b*; *c*, ventilating tube containing small rotary fan; *K*, ventilating slide; *M*, hot-water cans; *O*, slide closing hot-air chamber.

necessary, an additional shawl or blanket may be thrown over the incubator, care being taken that none of the weight be borne by the infant. A thermometer should be put alongside the child, and the temperature should be kept between 87° and 92° F. The air of the room in which the incubator is to remain should be kept pure and at a uniform temperature of about 71° F. Constant attention by day and by night is essential to the proper regulation of the temperature of the incubator.

The Prevention of Exhaustion.—After the child is placed in the incubator it should be disturbed as little as possible, as all movement, whether passive or active, requires on the part of the infant more or less expenditure of vital force. For this reason, and for the additional reason that exposure will rob it of body-heat, the child should be bathed not oftener

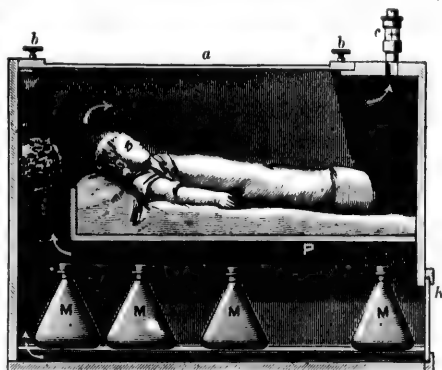


FIG. 447.—Interior view of a modified Auvar incubator (Fig. 446).

than once a day, and then with warm sweet oil, and this bath should be given with as little exposure and handling as possible. The absorbent pads arranged about the genitals should be changed sufficiently often to ensure cleanliness, but this change should also be made gently and without exposure. Another source of exhaustion would be the muscular effort required in sucking if the child were put to the breast or if it were required to nurse from a bottle, so that some other method of nourishing the infant should be adopted.

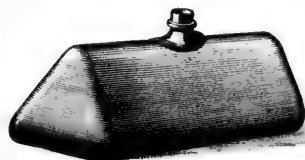


FIG. 448.—Hot-water can for modified Auvar incubator.

The Administration of Nourishment.—The premature infant should receive at stated intervals a definite amount of nourishment, the quantity and frequency of its administration depending somewhat upon its age and upon the indications arising from time to time. If for any reason the mother's milk cannot be used and a suitable wet-nurse cannot be obtained, the child's nourishment should consist of cow's milk, properly sterilized and diluted and otherwise modified to suit the age and condition of the infant. The greatest care should be observed in the preparation of the nourishment, whether it be taken from the breast or be prepared from cow's milk, and in its administration, so that the child will receive it free from germs. Milk may be given from the beginning, or the child may receive during the first day from 10 to 20 minims of warm water, containing 2 minims of whisky, every one or two hours. From 1 to 2 drachms of warm nourishment should be given every hour at first, the amount and the interval being very gradually increased after the child shows evidence of increasing weight and strength. In the administration of the nourishment one of the following methods may be chosen.

The simpler procedure, and the one most practicable for ordinary cases in private practice, consists in introducing the food, a few drops at a time, into the back part of the mouth or pharynx by means of an ordinary medicine-dropper or small glass piston syringe. When breast-milk is available, the mother's or the nurse's breast should gently be stroked with the finger-tips until the milk flows freely, when, by means of a breast-pump, 2 or 3 drams of milk are withdrawn and placed in a warmed and clean receptacle, from which the amount of food required is immediately given to the infant.

The second method is known as *gavage*. The infant is placed horizontally on the nurse's lap, with head slightly raised. A No. 14 or 16 (French) soft-rubber urethral catheter, thoroughly sterilized, is first anointed with a little of the food to be given. The end is introduced into the pharynx, and from there, as the child swallows, it is gently passed on into the stomach. When the catheter has been introduced 15 centimeters (6 inches) its tip has entered the stomach. From a small glass funnel or syringe inserted into the outer extremity of the tube the milk fresh from the breast or the artificial food warmed to a temperature of 95° F. (35° C.) is allowed to pass slowly into the stomach. In withdrawing the tube it should be done with a rather quick motion, in order to prevent the milk from following it. Rapid withdrawal of the catheter is facilitated by placing the forefinger of the left hand upon the tongue and depressing it. If the presence of the tube causes no inconvenience, it may be left *in situ* over several feedings, being removed two or three times a day for the purpose of cleaning it. After the child gains strength, and when its power to suck is sufficient, it may be given the breast several times a day, gavage and nursing being thus alternated until nutrition is well established.

The carrying out of these several essentials in the proper care and management of the premature infant requires the most patient and careful attention on the part of the nurse. The temperature of the incubator will require

close attention to prevent too high or too low degree of heat. The cleanliness of the child and of the appliances used at each feeding is also an important detail. The slightest neglect in any particular is apt to prove disastrous to our efforts. While this is especially true as regards the child born between the twenty-fourth and the thirtieth week, the child born later than this should not therefore be in any way neglected. If the eight months' children were treated, for a time at least, exactly as are those of seven months, more of them would be saved.

The following statistics show what has been accomplished by incubation and gavage: Of infants born at the sixth month, 22 per cent. survived; at the seventh month, 38 per cent.; at the eighth month, 89 per cent.; at eight and one-half months, 95 per cent. The probability of rearing a prematurely-born infant after the period for incubation and gavage has passed is largely dependent upon the care exercised throughout the first year or two of life. Children born prematurely to parents in good circumstances will very often survive infancy, while the infants of the poor not infrequently succumb to intercurrent disease.

VI. OBSTETRIC SURGERY.

I. INSTRUMENTAL OPERATIONS.

General Requirements and Preparations for Operations.—Most of the bad results following obstetrical operations are due to the carelessness rather than to the ignorance or inexperience of the operator. Though most physicians feel that in the practice of medicine and surgery they must be painstaking, methodical, and familiar with recent advances in knowledge, yet in obstetrical work they are apt to be careless and indifferent, trusting that nature will supplement all deficiencies and somehow pull the patient safely through. Many who pride themselves upon their scientific precision as physicians or upon their expertness and rigidity of technique as surgeons are nevertheless slovenly and careless as obstetricians. This anomalous state of affairs may be due to the wide diffusion of the erroneous idea that pregnancy is a physiological process whose natural termination is labor, and that consequently no special care or precaution is necessary. "Meddlesome midwifery is bad" is a half-truth which has done much harm, cramping scientific effort and serving as an ever-ready excuse for the delays and procrastinations of incompetence and ignorance. Obstetricians can never do good, safe work until they learn to regard every confinement as a surgical case with many pathological possibilities to be avoided or to be overcome, rather than as the natural termination of a physiological process. Operative midwifery is a department of surgery governed by the principles and rules of surgery. Operative precision cannot be attained, nor can mortality and morbidity be reduced to the utmost, unless practice is based upon broad surgical principles, and the same attention is paid to technique as in operations upon other parts of the body. In the main, modern surgery owes its success to the observance of a rigid antisepsis. Surgical cleanliness is imperative in even the smallest operations if the best results are to be obtained. In no department is this more important than in operative obstetrics, and in none does disaster follow carelessness and neglect more speedily and surely. It cannot therefore be too strongly impressed upon all who practise the obstetric art that *a rigid technique is essential*, and that success or failure will depend more upon surgical cleanliness than upon mere expertness in operating. Septic micro-organisms do not normally exist in the uterus nor in the upper part of the vagina; they are not formed *de novo* in the parturient canal, but must be introduced from without. Indeed, the micro-organisms which do exist in the vagina seem to be part of nature's line of defence against invaders from without. The doctrine of *autoinfection* as commonly expounded, if allowed to

influence our rules of practice, can do nothing but harm, and therefore cannot too severely be condemned. The man who believes that a patient can generate in her own body septic matters *de novo*, and can thereby infect herself notwithstanding rigid antiseptic precautions, will sooner or later relax those precautions, and have ready to hand a salve for his conscience when septicemia does arise; but the one who makes it his working hypothesis that septicemia always arises from infection introduced from without as the result of some failure in technique will be stimulated to watch his methods with ever-increasing care, seeking for the weak points in his defence and profiting by his errors and failures. It has well and truly been said that the doctrine of autoinfection is the gospel of despair and tends to paralyze honest effort.

In obstetrical as in all other operations it is of prime importance to see that the field of operation and everything coming in contact therewith (hands, instruments, dressings, etc.) are thoroughly aseptic, and are kept so throughout the operation and as much as possible during convalescence. This is perhaps harder to do in obstetrical than in general surgical work, on account of the anatomical arrangement of the parts and the difficulty and inconveniences under which operations must be performed. The external genitals and the vagina should receive special attention, being thoroughly scrubbed and washed with soap and hot water and then douched with a hot solution of some reliable disinfectant according to the circumstances of the case. Some use corrosive sublimate (1 : 1000, 1 : 2000, 1 : 4000); others prefer ercolin, lysol, carbolic acid, permanganate of potash, etc. Good or bad results can be obtained with any of these agents, as more depends upon the thoroughness of the cleansing than upon the choice of the antiseptic. Plenty of hot boiled water is sufficient in most cases, with perhaps the addition of a little ercolin. Lubricants are unnecessary and had better be avoided. Sponges are a fruitful source of trouble; a fairly good substitute can be made by sewing up rolls of absorbent cotton or of sterilized gauze of convenient size in a gauze covering; they can be sterilized just before operation and be destroyed afterward. Instruments are now made with metal handles, so arranged that they can easily be taken to pieces and cleaned. Sterilized sutures and ligatures are also readily obtainable, and there is no good reason why an obstetrician nowadays should ever use instruments or dressings which are not surgically clean. Great care should be taken with the hands and the nails, and precise directions should be given to the nurse as to the cleansing of the vulva and the perineum and the renewal of pads. These are all-important matters of detail, but they cannot here be discussed thoroughly. Different operators have different methods, but all have the same aim—the maintenance of surgical cleanliness. The tendency seems to be toward simplification of method; details may and do change, but principles never.

Passing the Catheter.—This little operation may be required during pregnancy, labor, or the puerperal period. During *pregnancy* two factors co-operate in causing retention of urine: (1) Mechanical disturbance of the natural relations, and (2) loss of tone in the muscular fibres of the bladder. During *labor* retention of urine from mechanical pressure is a common cause

of delay in the second stage, and emptying the distended bladder often removes the so-called "uterine inertia" and allows labor to proceed. During the *puerperium* retention frequently occurs from the sudden removal of intra-abdominal pressure. The uterus is smaller and the abdominal walls are laxer than before; the bladder, suddenly deprived of its wonted support from before and behind, is apt to distend and to be unable to empty itself.

Choice of Instrument.—A soft-rubber male catheter (No. 8, 10, or 12 English) is most suitable. Hard instruments of metal or of glass and the gum-elastic catheter with stylet are usually more readily rendered aseptic, but require very gentle manipulation.

Position of Patient.—The *dorsal* position, with limbs drawn up and *everted* so that the vestibule may be put upon the stretch, is preferable, because it brings the meatus within easy reach. The lateral position presents no special advantages and greatly impedes manipulation.

Method.—The meatus is exposed and thoroughly cleansed with a pledget of cotton and an antiseptic solution. Two fingers of one hand are used to separate the labia, and after locating the meatus the catheter, chemically clean and lubricated with an antiseptic lubricant, is held in the other hand and passed visually into the meatus to avoid carrying into the urethra any infective material that may be near the urethral orifice.

During labor it may be difficult to get the catheter through the urethra into the bladder if the presenting part is wedged low down in the pelvis. The following manoeuvres will generally suffice to overcome the difficulty: First: place two fingers of one hand upon the presenting part, and lift it up out of the pelvis as far as possible while the catheter is guided into the bladder with the other hand. It may be necessary to hold the presenting part away until the bladder is empty. Second: should the first manoeuvre fail, place the patient in the knee-chest position; the uterus and the presenting part will gravitate away from the pelvis, allowing the catheter to slip easily into the bladder. The latter method seldom fails unless the presenting part is too firmly wedged to be displaced. In the puerperal period considerable difficulty may be encountered during the first few days, especially in primiparæ. Edema or laceration of the parts may so distort the natural relations that the meatus may be drawn over to one side or even down under the anterior vaginal border. It is sometimes necessary to expose the vestibule before the displaced meatus can be found. When the catheter has been passed, one should make sure that the bladder is completely emptied by pressing upon the hypogastrium while the urine is flowing. The instrument must be perfectly clean; preferably a new one should be used for each case. If needed from day to day, the catheter should be cleansed thoroughly immediately after use and be kept in a 2 per cent. solution of carbolic acid; before being used again it should be rinsed and washed with hot water to remove all traces of the acid, or an irritating urethritis or cystitis may be set up. It is important to have the vestibule freed from all discharges before the catheter is passed; to do this properly the labia should be well separated, the vestibule exposed, and a vulvar douche be given.

The Douche.—There are three kinds of douche, the *vulvar*, the *vaginal*, and the *uterine*. The first two are usually entrusted to the nurse; the last should be given by the physician.

Vulvar Douche.—As the vulvar cavity extends to the vaginal entrance, a vulvar douche should clean all that portion of the genital tract which lies anterior to the vagina. To do this properly the patient should be in the dorsal



FIG. 449.—Curved intra-uterine nozzle.

position, with the limbs everted and the labia separated with two fingers; the vulvar cavity can then easily be flushed out with an ordinary vulcanite or glass nozzle (straight or rose; Fig. 449) or by pouring water from a pitcher or a

bottle, or it can be washed clean with jute or gauze pads, which can then be destroyed. Unless properly instructed, nurses are very apt to wash over the *outside* of the vulva only, instead of cleansing the whole vulvar cavity.

Vaginal Douche.—The vaginal douche may be given warm or hot, a cold douche being rarely required; it may be plain or medicated, the latter being required only in special cases. The patient should be in the dorsal position. If a large vaginal douche is required, she should be placed across the bed with the hips well over the edge, the thighs everted, and the feet resting upon a chair. A Kelly pad or a rubber sheet should be so arranged as to carry the

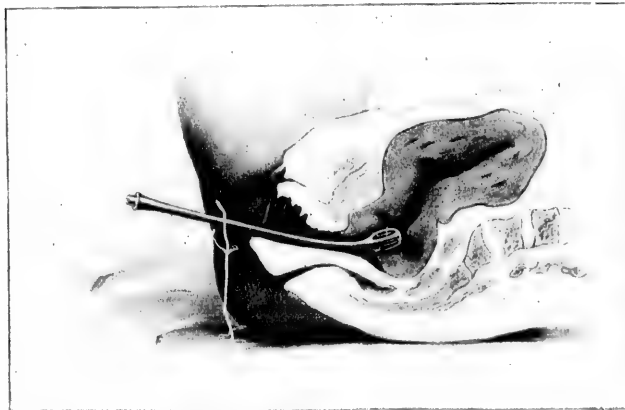


FIG. 450.—Intra-uterine nozzle, being almost straight and barely entering the cervix, is unable to flush out the uterine cavity.

water into a sufficiently large receptacle below. A vaginal douche during labor or the puerperium should be given in large quantity, the object being to convey a volume of water with but little force, cleansing the parts by the amount of fluid rather than by the force with which it is introduced. Nozzles are made of glass, of metal, or of vulcanite; they are straight or curved, with openings at the point or at the sides in the form of pinholes or of longitudinal eyes or slits. Glass nozzles are good, but they are fragile and must be handled with care;

metal is such a good conductor of heat that a very hot douche through a metal nozzle can hardly be borne; vulcanite is the best, but it is apt to lose its shape when boiled. The openings should be in the form of slits rather than pinholes,

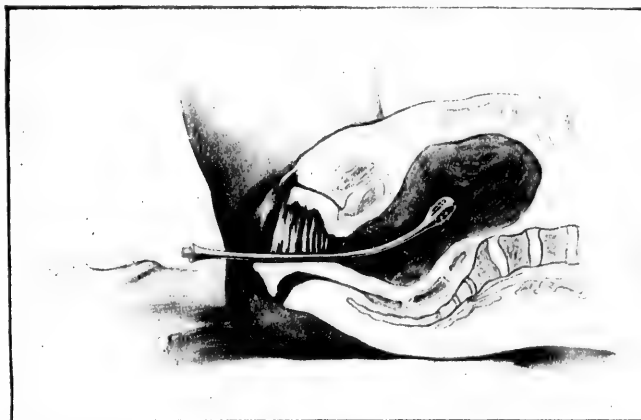


FIG. 451.—Intra-uterine nozzle passed into lower uterine segment, the uterine cavity not being satisfactorily flushed out; the perineal body is strongly depressed to elevate the tip of the tube.

and on the sides of the nozzle, never on the point. In giving a vaginal douche the practical point is to make sure of a sufficient outflow. The fluid should flow out as rapidly as it flows in, otherwise there will be ballooning and distention of the vaginal canal. Two fingers should be introduced into the

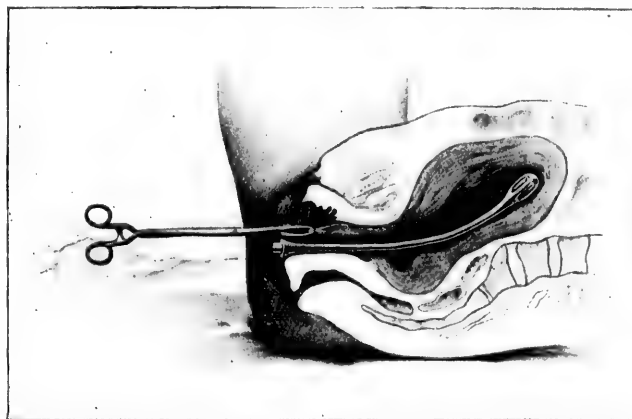


FIG. 452.—Anterior lip drawn down with volsella, and curved nozzle passed up to the fundus: whole uterine cavity being flushed from above downward.

vagina and be separated like a glove-stretcher; the nozzle is passed between the fingers, and a good outflow is thus maintained. Where the parts are roomy the same result may be obtained by pressing the nozzle firmly against

one side of the vagina. Double catheters are unnecessary; they are expensive, hard to keep clean, and do not give sufficient flow for obstetric work unless they are of extra large size. When the douche is finished the vagina should be emptied of fluid. If corrosive sublimate or other poisonous antiseptic has been employed, a pint or two of plain hot water should be run through to wash away or to dilute any fluid that may have remained in the vagina, thus diminishing the risk of absorption.

Uterine Douche.—The position of the patient and the general arrangements for the uterine douche should be the same as those for the vaginal douche. A large-sized inflexible nozzle of glass or of vulcanite with a pelvic curve should be selected. The delivery-tube should be of large calibre, in order to give a full-sized stream; the small tubes attached to the ordinary douche apparatus of the shops are useless for obstetric work. Objection is sometimes taken to the large-sized uterine nozzle, but, as a general rule, a uterus that needs douching easily admits the passage of a good-sized nozzle (Figs. 450–452). In the puerperal period the uterine douche is employed to flush out the uterine cavity and to remove debris, shreds, clots, and discharges. This removal can be effected thoroughly and satisfactorily only by discharging a large quantity of fluid at the fundus without force and by flushing the uterine cavity from above downward; the nozzle must therefore be carried up to the fundus. No difficulty will be found in passing the nozzle if the anterior lip of the cervix is seized with a pair of blunt bullet-forceps and drawn gently downward, so as to straighten the canal and to bring its axis more in line with the vagina. Care should be taken that tube and nozzle contain no air and that the vagina be washed out before the nozzle is passed into the uterus. The fundus should be supported by the hand while the douche is being given, and a good outflow should be secured to prevent distention of the uterine cavity. Slight traction upon the anterior lip will generally suffice to keep the cervix open and to allow the fluid to flow freely away. If sublimate has been employed, some plain hot water should be used as in the vaginal douche. When the nozzle is withdrawn the uterus should be made to expel any fluid that may remain before the bullet-forceps is removed.

The chief dangers of the uterine douche are that fluid or air may be forced into the Fallopian tubes and thence into the peritoneal cavity; or that clots may be dislodged from the placental site, causing hemorrhage or permitting the entrance of fluid or air into the sinuses; or that poisoning may result from the absorption of some of the antiseptic. Chill and rise of temperature often occur a few hours after a uterine douche, especially in nervous or debilitated patients. These unpleasant symptoms may be avoided or be minimized (1) by giving a stimulant a few minutes before the douche; (2) by having the injection-fluid *hot*; (3) by rapidity and gentleness; and (4) by so covering the patient that she is not exposed to chill while the douche is being given.

Curettage.—This operation is indicated (1) in cases of incomplete abortion when portions of the ovum or placenta are retained that cannot be removed by means of the finger or the ovum forceps, and (2) in the *puerperium* when

septic symptoms have appeared which are probably attributable to the decomposition of pieces of placenta or membranes in the uterine cavity.

In cases of incomplete abortion before the end of the third month it is generally possible to remove the ovum completely by means of the finger. The vagina having been thoroughly douched and the operator's hands disinfected, the patient is placed in the dorsal position and anesthetized. The fundus is then depressed as far as possible, so that a finger may be passed up to explore the uterus thoroughly and remove any portions of the ovum which may still be adherent. Occasionally the greater part of the hand must be introduced into the vagina to enable the finger to reach the fundus. If the finger is found to be insufficient, the hand should be withdrawn, and the anterior lip seized with a volsella or a strong bullet-forceps to steady the uterus. Schultze's ovum forceps (Fig. 453) may be introduced first and an attempt made to remove the retained



FIG. 453.—Schultze's ovum forceps.



FIG. 454.—Blunt curette.

fragments. If this instrument fails also, a blunt curette (Fig. 454) should be passed into the uterus and gently manipulated until all adherent pieces are detached. It is important that the fundus be kept well depressed and the uterus steadied by the volsella while curetting is being done.

In the *puerperium*, if portions of placenta or membranes remain attached to the uterine wall, a douche will be insufficient to remove them, and they will not come away until uterine contraction has separated them entirely from their attachments. If septic symptoms have appeared, it would be dangerous to wait for their slow natural separation, and the blunt curette may be employed to remove them immediately. The instrument should be long and inflexible, the beak being bent at an angle with the shaft. The patient having been placed in the dorsal position, the anterior lip is seized with a volsella and drawn well down in order to straighten the uterus and open the cervical canal. The curette is then introduced and made to explore the whole uterine cavity carefully. The scraping should be done very lightly, no force being used, as



FIG. 455.—Doléris's écouvillon.



FIG. 456.—Modified écouvillon.

the uterine walls are thin and softened, and there is always danger of perforation unless the utmost gentleness is used. The greatest difficulty is experienced when the retained piece of placenta is situated at the fundus or in one of the cornua. After the uterus has been curetted, a hot intra-uterine douche should be given and an iodoform bougie passed up to the fundus. Some operators prefer packing a strip of iodoform gauze into the uterine cavity and allowing the end to protrude through the cervix, in order to promote contrac-

tion and secure free drainage. When no portion of the placenta has been retained, but the cause of septic infection is decidual débris or shreds of membrane, the brush (*écouvillon* of Doléris, Figs. 455, 456) is more effective than the curette and is much safer. Having been soaked in very hot water to soften the bristles, it is passed into the uterine cavity and gently rotated until it reaches the fundus. A few turns are usually sufficient to free the uterine walls from débris. The brush is then withdrawn, a hot intra-uterine douche administered, and an iodoform bougie or strip of gauze introduced as after curetting. The writer has modified the brush somewhat to enable it to reach the cornua in difficult cases. The operations of curetting and brushing are sometimes of great service, but are always attended with risk. They should be employed only in selected cases, and should be practised with the utmost gentleness. Neither curette nor brush should ever be used until the uterus has been steadied and its walls put on the stretch by means of the volsella. When the uterus is curetted or brushed, the operation should be done so thoroughly that it may not require to be repeated. If the septic symptoms continue, some practitioners are in the habit of curetting again and again, in the vain hope of thereby removing the focus of infection. Such practice cannot be too severely condemned, since it is rarely necessary to curette or brush more than once or twice. It has been urged as an objection to these operations that the brush and curette denude the uterine walls and open up fresh avenues for infection. Experience proves that such objections are groundless if the operator is careful of his technique.

The Tampon.—The tampon may be applied to the vulva, the vagina, the cervical canal, or the uterine cavity. The *vulvar tampon* is used in cases of labial thrombus where rupture has taken place and there is continuous oozing or free hemorrhage. The clots are turned out of the ruptured sac and the cavity is tightly packed with strips of iodoform gauze. Occasionally it may be necessary to pack the vagina also, in order to secure sufficient compression to make the tampon effective. The *vaginal tampon* is useful in cases of inevitable abortion in the early months of pregnancy, when the cervix is not sufficiently dilated to allow the finger to be passed into the uterine cavity in order to remove the ovum. When properly applied in such cases the vaginal tampon checks hemorrhage, stimulates the uterus to more active contraction, and allows time for the patient to rally from the effects of hemorrhage before other measures are employed. The tampon is sometimes used to induce labor by stimulating uterine action: the *intracervical* tampon is then employed, reinforced by the vaginal tampon. But in placenta previa the tampon is of the greatest value; the cervical canal and the vagina are packed firmly enough to check hemorrhage and to prevent the escape of blood from the vulva. The tampon acts directly and indirectly: directly by dilating the cervix, distending the vaginal vault, and making direct compression; indirectly by exciting the uterus to vigorous contraction. The tampon is used also in hydatidiform moles as soon as the diagnosis is certain and hemorrhage has begun. It is occasionally of service in the treatment of post-partum hemorrhage, when the uterine muscle is weak and inert and cannot be stimulated to contract by other

means. In cases of rigid cervix or prolonged first stage in primiparae it is sometimes employed as a dilator; it is claimed that by its use labor is shortened, the mother is spared much pain, and the child's life is placed in less jeopardy.

Materials for Tampon.—Various materials have been used for tampons, such as sponges, tents (sponge and tupelo), balls or pledgets of cotton wrung out of an antiseptic solution, strips of linen or cotton or sterilized gauze, either plain, borated, carbolated, sublimated, or iodoformed. Charpie is used extensively in France. A favorite tampon in Germany and in France is a rubber bag (colpeurynter) introduced flaccid and subsequently dilated with air or with water. When used as vaginal tampons these rubber dilators cannot be so firmly applied and do not make such even, steady pressure as the old-fashioned tampon. They are more useful as cervical dilators in cases of placenta prævia. Gauze, charpie, and absorbent cotton are safer than sponges.

Vaginal Tampon.—Absorbent cotton is soaked in carbolized water, the excess of fluid being squeezed out, and fifty or sixty balls or pledgets are prepared, each being about the size of a walnut. Some obstetricians use these pledgets separately; others attach them to a string or a strong thread at intervals of 6 or 8 inches, as in a kite-tail. Astringents are unnecessary, for they do not come in contact with the bleeding surface and they only serve to irritate the vaginal mucous membrane; a weak solution of carbolic acid is better. The pledgets having been prepared, the patient is placed in the Sims position, the perineum is retracted with a Sims speculum, and the cotton balls

are carried up with long dressing-forceps and packed closely around the vaginal portion of the cervix, then over the os, then from above downward into the vagina until it is sufficiently well filled (Fig. 457). It is seldom necessary to pack the whole vagina, although in some cases this must be done. A T-bandage is then applied to keep the tampon *in situ*. When carefully packed about the cervix and filling out completely the dilatable upper portion of the vagina, the tampon is a perfect safeguard against hemorrhage. The tampon may be left undisturbed for twenty-four hours, and is then removed piece by piece

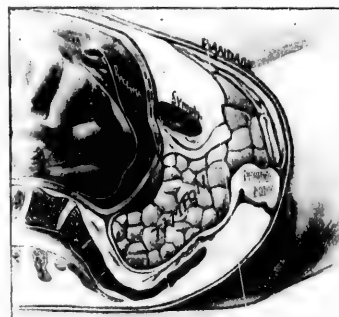


FIG. 457.—Tamponing the vagina with pledgets of cotton tightly packed around the cervix, more loosely in the lower portion of the vagina; guard and T-bandage are applied; case of placenta prævia with undilated cervix.

from without inward, the vagina is thoroughly douched out, the bladder and rectum are emptied, and another tampon is introduced if necessary. A third tampon is seldom required. Too frequent tamponing irritates the vagina, causes more or less odor, and exposes the patient to the risk of septic infection. After twenty-four hours' tamponing many operators prefer to use carefully prepared sponge or tupelo tents, but, as a rule, tents are not to be recommended.

The Sims speculum is not always available, and it may be dispensed with. The patient is then placed in the dorsal position with legs and thighs flexed. The labia having been separated with two fingers, the pledgets of cotton are carried up to the vaginal vault and firmly packed about the cervix. The first balls may be smeared over with an ointment containing iodoform, boric acid, or carbolic acid. One layer after another is thus introduced until half the vagina is well filled. Many obstetricians prefer strips of absorbent cotton instead of balls or pledgets, because they are more easily removed; others use strips of sterilized gauze, either plain or medicated (Fig. 458). The strips should be 25 or



FIG. 458.—Tamponing the vagina with strips of gauze or cotton.

30 centimeters (10 or 12 inches) long and 5 or 7.5 centimeters (2 or 3 inches) wide; they should be smeared on one side with ointment, and be packed about the cervix in the same way as the pledgets. French obstetricians use ointments and cerates in large quantities when applying the vaginal tampon. Charpentier says that a pound or more of charpie may be required to seal the vagina hermetically; he prefers a borated cerate. Auvard, who uses cerates, says that sometimes as much as 500 grams (16 ounces) may be required; he lays great stress upon the abundant use of cerate. In applying the vaginal tampon some obstetricians begin by packing the cervix first, and then the anterior and posterior cul-de-sac, while others reverse this order. At all events, the occlusion of the uterus and the vagina must be hermetic, otherwise the tampon will be painful as well as ineffectual; it is therefore necessary in all cases to take great pains in packing the cul-de-sac gently and thoroughly, but not forcibly. Great differences of opinion seem to exist as to the length of time the tampon may be left *in situ*. From one hour to thirty-six hours are the limits that have been suggested.

Intra-uterine Tampon.—The intra-uterine tampon was introduced in 1887 by Dührssen. Plain antiseptic gauze is the best material; it attaches itself to the uterine walls, soaks up and drains away fluid, and swells when moistened without becoming hard or uncomfortable. It is used in strips 45 centimeters (18 inches) long and from 2.5 to 7.5 centimeters (1 to 3 inches) broad. When well applied it can be retained for forty-eight hours without danger or incon-

venience. In cases of post-partum hemorrhage the quantity which can be stuffed into the uterus is very great. Half a dozen sterilized gauze bandages 7.5 or 10 centimeters (3 or 4 inches) wide are not too much. The intra-uterine tampon is useful in hemorrhage at full term or after abortion, or where there is septic matter in the uterus after labor or abortion, whether curetting has been done or not; it is useful also when the uterus contracts imperfectly or irregularly after labor or abortion. In subinvolution it stimulates uterine contraction, relieves the turgid veins, and secures good drainage; in such cases it is generally preceded by irrigation and curetting.

Method of Application.—The bladder and the rectum having been emptied and the vulva and the vagina having been thoroughly cleansed, the anterior and posterior lips of the cervix are drawn down by means of two volsellæ. If the hemorrhage has occurred just after delivery and the hand can be passed into the uterus, the volsellæ are unnecessary. The uterine cavity having been cleared of clots and debris, a strip of gauze is carried up to the fundus and packed in until the free space about the fundus is completely filled. The firmness of packing is determined by the circumstances of the case; allowance should be made for the swelling of the gauze when soaked with secretions. When the uterine cavity has been sufficiently filled the volsellæ are removed, the vagina is lightly packed, and a firm abdominal bandage is applied. The tampon may be left in place for one, two, three, or even four days, according to circumstances, or it may be removed and renewed from day to day. Tamponing has been kept up in a myomatous uterus for a week. The state of the bladder and the rectum must carefully be watched while the tampon is in place. There are no contra-indications to the intra-uterine tampon if it is modified as to quantity, firmness, and length of application according to circumstances. It is easily removed by simple traction.

Episiotomy.—The term *episiotomy* is applied to the operation of incising the genitals during delivery to prevent their laceration, substituting a clean cut of definite size in a place where it can do no harm for a ragged tear of indefinite size in a place where it may cause immediate danger and subsequent injury. This name was given the operation by Michaelis (1799), who incised the median raphé of the perineum to prevent extensive laceration, but it is now applied to any incision of the external genitals for a similar purpose. Episiotomy has fallen into comparative disuse in England, America, and France, but is still common in Germany and Austria. The indications are—threatening central rupture of the perineum; great narrowness of the external genitals; excessive rigidity of the soft parts, especially from the presence of cicatricial tissue; faulty presentation; and undue size of the child's head. Opinions vary as to the site, number, and size of the incisions, but each case must be treated according to the indications present. French obstetricians prefer the oblique incision (recommended by Tarnier) which passes to one or the other side of the anus. Chantreuil recommends that where rupture into the rectum is threatened a median incision be made along the raphé and then be carried obliquely off on both sides of the rectum, the incision taking the shape of an inverted Y. German

obstetricians prefer incisions directed obliquely toward the posterior commissure. It is claimed that an incision of 1 centimeter ($\frac{3}{8}$ inch) increases the circumference of the vulvar orifice 2 centimeters ($\frac{3}{4}$ inch). The incision should be made during a pain with a pair of straight, blunt-pointed scissors. Winekel and Schultze advise waiting until the epidermis at the frenulum begins to tear. In America most authorities depend more upon care and skill in delivering the head than upon incisions for the prevention of perineal laceration. But when the rupture of the perineum threatens to involve the rectum, as in difficult forceps cases or where rapid delivery is necessary, an oblique incision passing well to one side of the anus will often save the rectum and leave a wound which can more easily and satisfactorily be repaired. Moreover, it is not so liable to be contaminated with the lochia, and primary union generally results. The technique of episiotomy has been described and illustrated on page 373.

Premature Induction of Labor.—The course of gestation may be arrested artificially at any period in the interests of either mother or child. If it is arrested before the child is viable, the operation is called the "induction of abortion;" if after the child is viable, it is called the "induction of premature labor." The date of fetal viability is therefore the dividing-line between these two operations.

Indications for the Induction of Abortion.—When the further continuance of gestation would seriously endanger the mother's life, it is justifiable to induce abortion in the interests of the mother. In uncontrollable vomiting with progressive emaciation, where all other treatment has failed, abortion is indicated. In grave heart, lung, and kidney troubles, pernicious anemia, severe chorea, advancing jaundice, etc., prompt arrest of gestation may be the only means of saving the mother's life. Whenever there is such mechanical obstruction in the genital tract that the birth of a viable child is impossible, abortion may be induced. Excessive contraction or deformity of the pelvis, tumors mechanically blocking the pelvis, extensive cicatricial contraction of the vagina or the cervix, and advanced carcinoma of the uterus or the vagina are the commonest forms of such mechanical obstruction.

Indications for the Induction of Premature Labor.—When the continuance of gestation to full term would expose mother or child to serious risks which might be diminished or avoided by the arrest of gestation, the induction of premature labor is indicated. No absolute rules can be formulated, but each case must be judged upon its own merits. The success which has attended modern Cesarean section and symphysiotomy has limited the range for this operation. If the mother's life is not imperilled, it is better to allow the child to attain its full development, and to deliver by section or by symphysiotomy than to bring into the world an immature child whose chances of living and thriving are frequently less. *Pelvic deformity* which would prevent the birth of a living child at full term, but which would allow the safe delivery of a premature viable child, used to be considered one of the main indications for the induction of premature labor. A conjugate of 6.75 to 7 centimeters ($2\frac{3}{4}$ inches) in the simple flat pelvis and of 7.5 to 8 centimeters (3 to $3\frac{3}{16}$ inches) in the generally-contracted pelvis

are the lowest limits usually set. But by symphysiotomy a full-term child can generally be delivered through a pelvis as small or even smaller with probably little more risk to the mother. In deciding upon the operative measures to be adopted in cases of moderate pelvic contraction it is only just to remember the claims of the induction of premature labor and the good results it has yielded in the past. In certain grave diseases which threaten the mother's life this operation will always hold its place. In *placenta prævia*, when a severe hemorrhage has taken place labor should be induced in the interests of both mother and child. In *eclampsia* many authorities believe that the safest treatment is the induction of labor; others, however, strongly advocate the expectant plan. In chorea, advanced heart and lung troubles, general edema, jaundice, etc., the operation is sometimes imperative. When there is a dead fetus *in utero* injuriously affecting the mother's health, or where the mother is likely to die before labor sets in, there can be no doubt as to the advisability of the operation.

Time to Operate.—The best time to select for operation is from two hundred and forty to two hundred and fifty days from the cessation of the last menstrual period. It is better to operate too early than too late. Schroeder generally operated in the thirty-sixth, rarely before the thirty-fourth, week.

Prognosis.—The prognosis for the mother is generally good, but should always be guarded. Besides the increased risk of septic infection, the state of the mother's health may materially affect the prognosis. If there has been serious organic disease, the chances of recovery will be lessened. For the child, the more immature it is, the worse is the prognosis; between the thirty-second and the thirty-sixth week its tenure of life is feeble and it will require the greatest care. The use of the incubator and artificial feeding greatly improve the chances of rearing very feeble infants (see p. 862).

Methods of Operation.—A great many methods have been employed for the induction of labor. Some are efficient, but more or less dangerous; others are safe, but less efficient. Some are prompt, and are most useful when speedy results are required; others are slow, and are applicable only when time is not of importance. It is obvious, therefore, that no one method is applicable to all cases.

1. *Puncturing the Membranes* (known as *Scheel's Method*).—A sound, quill, or other pointed instrument is passed through the os uteri and is made to rupture the presenting bag of membranes. The liquor amnii drains away and uterine action is set up. This method is safe if the rules of antisepsis are observed, and is most useful when it is desired to relieve uterine tension; but it is slow, and labor is apt to be tedious and painful on account of the early loss of the waters.

2. *Introduction of an Elastic Bougie into the Uterus* (known as *Krause's Method*).—After a vaginal douche has been given two fingers are passed up to the external os, and if possible through the cervix to the internal os; a well-oiled solid bougie (No. 10 or 12) is passed along the fingers and is guided by them into the uterine cavity between the membranes and the muscular wall

(Fig. 459). It is then gently rotated and made to work its way several inches upward toward the fundus. The higher it can be made to go, the more certain and rapid will be the onset of labor. A light vaginal tampon of iodoform gauze is then applied to keep the bougie from slipping out and to prevent the entrance of air or septic matters into the uterine cavity. If active labor-pains have not begun in twenty-four hours, the tampon and the bougie are removed, a thorough



FIG. 459.—Bougie passed through the cervix and between the membranes and the uterine wall, and retained by a light vaginal tampon.

vaginal douche is given, and another bougie is introduced on the opposite side of the uterus. Usually one introduction of a bougie suffices to induce labor, though sometimes two or three, or even more, may be required; exceptionally the method may fail altogether, and other measures will have to be employed. Krause's method is the safest and best for ordinary purposes when a speedy result is not required, and it is the one in most common use.

3. *Tamponing the Vagina.*—A vaginal tampon of gauze or of cotton pledgets, or a rubber bag (colpeurynter, Fig. 460) passed up to the cervix and dilated



FIG. 460.—Colpeurynter.

with air or water, is sometimes a useful auxiliary in the induction of labor, but is too slow, uncertain, and painful to be relied upon alone. It is of great service in placenta prævia and in some cases of accidental hemorrhage. It is useful also to strengthen labor-pains which are growing weak or to apply

counter-pressure to a presenting bag of membranes which it is desirable to keep unruptured. The method of applying a tampon has already been described.

4. *Dilatation of the Cervix.*—When it is required to empty the uterus as rapidly as possible, it may be necessary to dilate the cervix artificially. For a description of this method see page 882. There is more or less risk attending forcible dilatation, and it should not be attempted unless the case is urgent.

5. *Intra-uterine Injection* (known as *Cohen's Method*).—A special nozzle or an elastic catheter is passed between the membranes and the uterine wall, as in

Krause's method ; water or some other fluid is injected through the nozzle until tension is complained of. The injected fluid separates the membranes from their uterine attachments and stimulates contraction. The nearer to the fundus the fluid is conveyed, and the larger the area of detachment, the more certain and active will be the contraction. This method is efficient but dangerous ; several fatal cases have been reported from shock and from entrance of air into the uterine veins.

6. *Vaginal Irrigation* (known as *Kivisch's Method*).—A stream of hot water (100° to 120° F.) is directed against the cervix for ten or fifteen minutes at a time every two or three hours until labor-pains set in. Some obstetricians use cold water, while others follow the hot douche immediately with a cold douche for the purpose of obtaining a more stimulating effect. This method is tedious, painful, and uncertain, and it involves risk of congestion and metritis. A hot douche seems occasionally to augment the action of other measures, but the cold douche is apt to do harm, and is not to be recommended for general use.

7. *Electricity*.—The mild faradic current is said to be sometimes very effective. The negative pole is applied to the cervix in the posterior vaginal cul-de-sac, while the positive pole is placed over the sacrum or the lumbar vertebrae. This method has not come into general use, although it has recently attracted some attention ; it is worthy of trial.

8. *Aspiration of the Uterus per Vaginem*.—When ordinary means fail and the case is very pressing, the uterus may be punctured and the liquor amnii aspirated. Two fingers are passed into the vagina and the most prominent portion of the corpus uteri is located. The aspirator-needle is then passed along the fingers and made to enter the uterine wall at right angles. After the liquor amnii has been aspirated the needle is withdrawn and uterine contraction closes the puncture.

9. *Injection of Glycerin* (known as *Pelzer's Method*).—A special nozzle or a flexible catheter is passed through the os internum as in the Krause method, and half an ounce of pure aseptic glycerin is slowly injected between the membranes and the uterine wall. Some operators then apply a tampon to the cervix to prevent the escape of the glycerin. Pelzer first used 100 cubic centimeters (3½ ounces) of glycerin ; he now prefers a smaller quantity (30 to 50 cubic centimeters) and repeats the injection if the first is unsuccessful. He explains the action of glycerin as an exciter of uterine contraction in three ways : (1) By mechanical separation of the membranes ; (2) by a direct irritant effect on the uterine mucous membrane, as in like manner rectal glycerin injections set up muscular contractions which persist as tenesmus after the bowel has been emptied completely ; and (3) by the affinity of glycerin for water, the liquor amnii being drawn through the membranes, causing more or less collapse. Pelzer does not use glycerin in eclampsia or in placenta previa unless the attachment is lateral and the injection can be made without injuring the placenta. Some operators claim equally good results from tamponing the cervix with pledgets of absorbent cotton soaked in glycerin. Pfannenstiel holds that Pelzer's method is

dangerous, because several cases have been reported in which glycerin produced nephritis. The method is still on trial; it has been warmly advocated by some obstetricians and severely criticised by others. The data are not yet sufficient to warrant a positive conclusion. Personally the writer has experienced most difficulty in securing the retention of the glycerin long enough to produce any decided effect.

As the operation of induction of abortion or of premature labor always involves more or less risk, it is advisable to obtain the advice and support of a colleague in consultation. Moreover, there often crop up certain moral and religious questions which the physician should not attempt to settle, but should leave to the decision of the family and its religious advisers. There have been employed for the induction of labor many other methods which do not merit serious consideration here.

Artificial Dilatation of the Os Uteri.—Labor may be delayed by the rigidity of the cervix or the external os, and it may be found necessary to dilate artificially in order to overcome the obstruction. Similar measures may be required when the condition of mother or child compels immediate delivery and the cervix is not sufficiently dilated to permit the use of forceps or other instruments. The dilators most commonly used for this purpose are either *hard* or *soft*. The hard dilators are made of metal or of vulcanite; the soft dilators are various patterns of rubber bags which are introduced into the cervix collapsed and are then distended with air or with water. In Germany Hegar's dila-



FIG. 461.—Hegar's dilators.

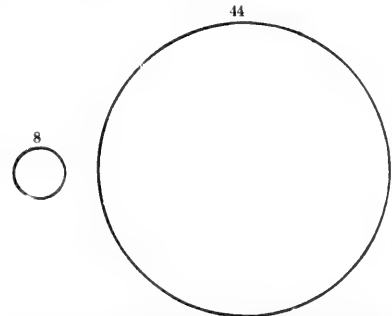


FIG. 462.—Actual calibre of Hegar's dilators, Nos. 8 and 44, showing the amount of dilatation produced.

tors are much used (Fig. 461). They are made of vulcanite, of polished steel, or of aluminum, and graduated from No. 1 to No. 44 or upward (Fig. 462). The smaller sizes can be passed through the cervix as easily as an ordinary uterine sound; the larger produce sufficient dilatation to permit the application of forceps or the introduction of one of the larger rubber bags.* The patient is placed across the bed in the dorsal position, with limbs everted and feet supported on a couple of chairs. The vagina is thoroughly douched out, the anterior and posterior lips of the cervix are steadied with volsellæ, and the fundus is pressed well down and supported by an assistant. The dilators, having been made aseptic and well oiled, are passed in, one after another, beginning with the smaller numbers. It is often

* The circumference of No. 44 is 14 centimeters (about 5½ inches).

possible to dilate the cervix sufficiently in half an hour or an hour, especially if the patient has been anesthetized. A speculum is seldom required. In



FIG. 463.—Six-branched dilator.

France a six-branched metal dilator (Fig. 463) or Tarnier's uterine dilator (Fig. 464) is preferred.* The latter instrument consists of two blades which



FIG. 464.—Tarnier's uterine dilator.

are introduced like forceps-blades, locked, and then kept separated by means of a rubber ring slipped over the end of the handles. The elastic pressure of the rubber gradually overcomes the resistance of the cervix, while the presence of the instrument stimulates uterine contraction in a reflex manner.



FIG. 465.—Barnes's bag.



FIG. 466.—McLean's model of Barnes's bag.

The soft-rubber dilators are of various kinds. Barnes's fiddle-shaped bags (Fig. 465), which are made in three sizes, are introduced by means of a sound.

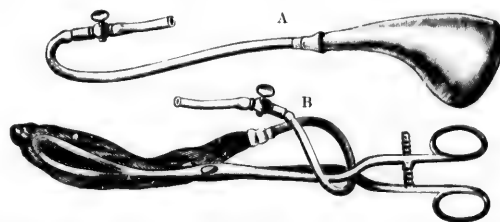


FIG. 467.—Champetier de Ribes's bag: A, Inflated; B, folded for introduction into the uterus.

McLean's modification (Fig. 466) is folded up as small as possible and passed into the cervix in the grasp of a pair of uterine forceps. When once fairly in place the bag is gradually inflated with air or with water until the required dilatation is secured. Tarnier's dilator (Fig. 468), consisting of a rubber

* Bonnaire gives a full description of this instrument, its mode of application, its action, and its effects in the *Archives de Tocologie et de Gynécologie*, 1891, pp. 778, 881.

tube terminating at one end in a dilatable ball, is introduced by means of a special sound. When properly placed the sound is withdrawn and water is pumped into the tube by means of a syringe fitting into the mouth-piece. The best of the soft dilators is that of Champetier de Ribes (Fig. 467).



FIG. 468.—Tarnier's uterine dilator *in situ*: the bag is round in shape, but is compressed by the intra-uterine tension.

The bag is made of silk covered with rubber, and when distended it forms an inverted cone 8 centimeters ($3\frac{1}{4}$ inches) in diameter at its base. The silk prevents bursting of the bag—a serious objection to the other soft dilators. The bag, folded as small as possible, well oiled, and grasped between the blades of an applicator (Fig. 467, B), is slowly pushed through the cervix until half of it has passed within the internal os. The applicator is then relaxed, but is not removed until the bag has been pumped half full of warm water to ensure its retention. The applicator is then withdrawn, and the bag is slowly pumped full and left *in situ*. It acts as an artificial bag of membranes and produces safe and easy dilatation. Uterine action may further be stimulated by making traction upon the bag during a pain. The bag also prevents

injurious pressure of the presenting part upon the maternal passages. Before the bag can be introduced the os must be dilated sufficiently to allow one finger to pass easily. It may be necessary to dilate to this extent with the finger or with Hegar's dilators. A similar dilatation may be required when Barnes's bags or other soft dilators are used. It is not essential for the membranes to be ruptured before the bag is introduced, though it is generally safer and better if they have been naturally or artificially ruptured. Champetier de Ribes's bag is a more powerful dilator than that of Barnes or Tarnier, and is also less liable to be displaced. Besides its use in placenta prævia and in the artificial induction of labor it has been found of great value in the treatment of accidental hemorrhage, prolapse of the funis, shoulder presentation with prolapse of an arm, and too early rupture of the membranes in slightly contracted pelves. The objections urged against it are that it may displace the presenting part or rupture the lower uterine segment if it is much thinned out; but if care is taken that the bag be not too suddenly or too forcibly distended, such accidents should not occur.

The Forceps.—So far back as the time of Hippocrates it was recommended in certain difficult cases of labor to seize the child's head with the hands and pull it down. This procedure was practically impossible until the

FIG. 469.—Forceps of Davis.



FIG. 470.—Forceps of Simpson.



FIG. 471.—Forceps of Barnes.



FIG. 472.—Forceps of Sawyer.



FIG. 473.—Forceps of White.



FIG. 474.—Forceps of Hodge.



FIG. 475.—Forceps of Dubois.



FIG. 476.—Forceps of Wallace.

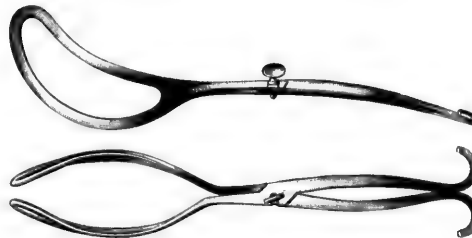




FIG. 477.—Forceps of Pajot.

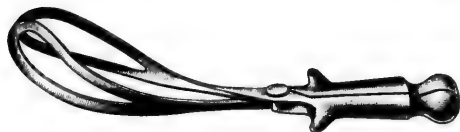


FIG. 478.—Forceps of Naegle.



FIG. 479.—Forceps of Elliott.

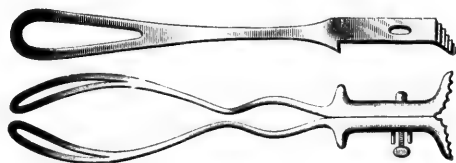


FIG. 480.—Forceps of Lazariewich (straight).

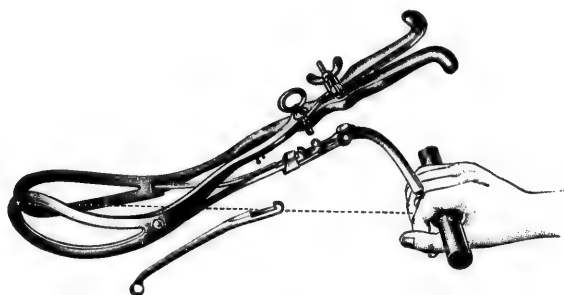


FIG. 481.—Axis-traction forceps of Tarnier (to show the details the hand is represented in an improper position for traction; below is one of the traction-rods).

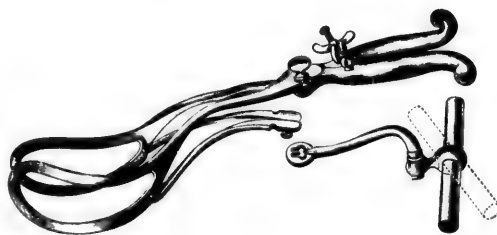


FIG. 482.—Lusk's modification of the Tarnier forceps (the traction-rods are shown free from the catches that hold them during application of the blades and ready for attachment of the tractor).

FIG. 483.—Axis-traction forceps of Simpson.

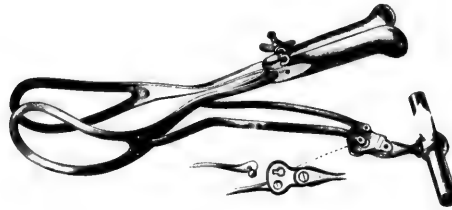


FIG. 484.—Axis-traction forceps of Breus (the rods having the right-angled bend are against the shank when application is made).

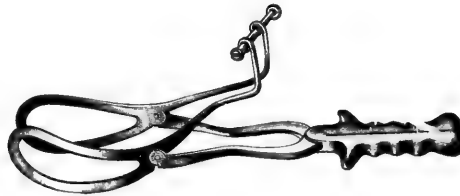


FIG. 485.—Axis-traction forceps of Poulet (tapes run through eyes in blades and through ring on traction shank, and fastened to a cross-bar).

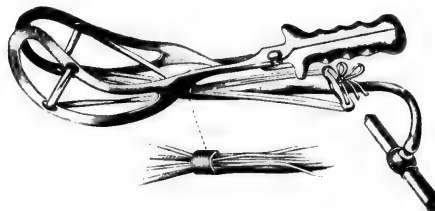
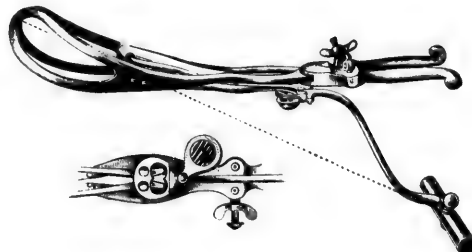


FIG. 486.—Axis-traction forceps modified by Jewett (after Milne-Murray's specifications, with details of lock).



invention of the forceps supplied the obstetrician with an instrument capable of being applied to the head while still in the parturient canal, and of exerting an amount of tractile force greater than that of the unaided hand. Although the use of forceps in obstetrics was mentioned by Avicenna (980-1030) and subsequently by other writers, it was not until the middle of the seventeenth century that the modern forceps was invented. The gradual development and perfecting of the instrument from the time of the Chamberlens to the present day make an interesting and instructive chapter in the history of medicine. Space does not permit a consideration of the historical side of the subject, nor a description of the numerous models which have been constructed, with their relative merits and demerits; it must suffice to point out the essential points of a good forceps and to indicate those models which are in most common use. No forceps is perfect or is equally adapted to all cases, and if a physician provides himself with only one pair, he should be careful to select a model which will be generally useful, even though it may be inferior for certain special cases. Moreover, he must use his forceps intelligently, knowing its limitations as well as its advantages, if he would minimize the risk of disappointment and failure.

The obstetric forceps consists essentially of two arms or branches, curved on the side so as to grasp the fetal head, articulated to maintain their hold, and provided with handles to facilitate traction. All forceps have this cephalic curve. The blades are usually fenestrated, to make them lighter and to give a better grip of the head with less compression. The wider the fenestration the firmer the grasp. In the Davis forceps (Fig. 469) great care has been taken to adapt the cephalic curve accurately to the contour of the head, and this curve has been adopted by Wallace (Fig. 476), Sawyer (Fig. 472), and others in the construction of the instruments which bear their name. Most modern forceps have a second curve (pelvic), to accommodate the instrument to the shape of the pelvigenital canal and to enable it to grasp the head firmly when situated at or just below the brim of the pelvis. Such instruments are sometimes called "double-curved" forceps. The pelvic curve is usually greater in French than in English and American instruments. Those possessing a marked pelvic curve are more suitable for high operations; those with moderate curve are more suitable for the low and medium operations, as they are less likely to interfere with natural rotation.

When the branches cross each other like scissors, they articulate at the junction of blade and handle; when they are parallel, as in the Asselini forceps, they articulate at the extremity of the handles. In some varieties the blade is joined to the handle by a shank, which gives solidity to the instrument and diminishes the elastic spring of the blades. The articulation is in the form either of the open English lock (Fig. 487) or of the more complicated French mortise and tenon, tightened by means of a screw to prevent the blades from disarticulating (Fig. 487). In some forceps there is a fixed tenon on one branch and a mortise on the other, but no screw to fix the joint. For general use the English lock is preferable. The handles may be quite plain, or be serrated, grooved, or roughened, to give a better hold. Some

have a ring in the shank (Barnes's, Fig. 471), or projecting shoulders (Simpson's, Fig. 470) to facilitate traction. Forceps, whether single-curved or double-curved, are either *long* or *short*. The short forceps is usually from 22.5 to 25 centimeters (9 to 10 inches) in length, the long forceps from 32.5 to 40 centimeters (13 to 16 inches); Tarnier's axis-traction forceps is about 45 centimeters (18 inches) long. The short forceps is now very little used; it is a relatively feeble instrument, adapted only for the low operation, and has no special advantages over the longer instrument, which is equally fitted for high, low, and medium operations. Sawyer's is the best model of the short forceps.

In recent years much attention has been paid to *axis-traction*—that is, traction in the axis of the parturient canal. Whenever traction is not in the right direction, a certain amount of the tractile force is wasted against the pelvic walls, and the maternal soft parts are apt to be injured. The fetal head, too, is subjected to more compression, since a greater amount of tractile force is required to effect delivery. The best axis-traction forceps is that of Tarnier (Fig. 481), either the French model or Lusk's modification (Fig. 482). The Breus forceps, so much used in Germany, is lighter and less clumsy, but not so powerful as that of Tarnier. Simpson added axis-traction rods to the ordinary Simpson forceps (Fig. 483), and tractors have been contrived for most of the well-known long double-curved instruments. Stevenson fits a blunt-hook tractor to the lock of the ordinary forceps and thus makes axis-traction. Poulet accomplishes the same result by means of cords passed through holes drilled in the cephalic portions of the blades (Fig. 485). The axis-traction forceps is useful in the high operation, but is unnecessary and cumbersome in the low operation; the higher the head the more useful will this kind of forceps be found.

A good forceps should be made of well-tempered steel; the blades should be well polished and nickel-plated, and heavy enough to be firm without too much spring. The cephalic portion should be comparatively light and the shanks strong, the edges of the blades and the fenestræ being rounded and smooth. The fenestræ should be of moderate width (from $1\frac{1}{4}$ to $1\frac{1}{2}$ inches); the tips of the blades should be from 1.3 to 2.5 centimeters ($\frac{1}{2}$ to 1 inch) apart when closed, the greatest distance between the blades in the cephalic portion being from 6.3 to 7.5 centimeters ($2\frac{1}{2}$ to 3 inches). The blades should lock easily; the handles should be of metal, smooth, and provided with a convenient shoulder for traction. Wooden handles, complicated locks, and compression-screws should be avoided, and the instrument should be so constructed that it can easily and thoroughly be rendered aseptic. In England the favorite forceps is that of Simpson or of Barnes, or the Simpson-Barnes, which has the Barnes blade and the Simpson handle. In America the Simpson (Fig. 470), Barnes (Fig. 471), Hodge (Fig. 474), Wallace (Fig. 476), White (Fig. 473), and Sawyer forceps are extensively used. In France some modification of the orig-

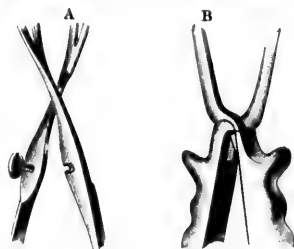


FIG. 487.—English (A) and French (B) locks.

inal Levret is used, such as the Dubois (Fig. 475), Pajot (Fig. 477), or Stoltz forceps; for axis-traction the Tarnier forceps (Fig. 481) is the favorite, though many prefer the simpler Poulet (Fig. 485). In Germany the Naegele (Fig. 478) or Braun's modification of the Simpson forceps seems to be in commonest use; for axis-traction the Breus (Fig. 484) and the Simpson (Fig. 483) models are preferred to that of Tarnier. Generally speaking, those obstetricians who follow the English method, and apply the forceps to the sides of the pelvis regardless of the position of the fetal head, use the Simpson or the Barnes forceps or some modification of them; while those who follow Baudelocque and use the Continental method, applying the forceps to the sides of the child's head regardless of its position in the pelvis, prefer the Continental model of forceps, which is usually a modification of that of Levret.

Action of the Forceps.—The obstetric forceps may act in four different ways: (1) As a *tractor*, (2) as a *compressor*, (3) as a *lever*, and (4) as a *rotator*.

1. *Tractor.*—Traction supplements a deficient *vis-a-tergo* by sufficient *vis-a-fronte* to effect delivery, or replaces it altogether if the driving power of the uterus has become exhausted. The amount of force applied is under the control of the operator; it may be much or little, continuous or intermittent, according to the necessities of the case. During traction there is always a certain amount of compression and leverage, and usually more or less rotation. The forceps, therefore, cannot be used as a tractor only, but becomes a lever, a compressor, or a rotator of greater or lesser power according to the amount and direction of tractile force employed. To be a good tractor the forceps must have a good grasp of the head, and the blades must not slip or spring apart when traction is made. To effect delivery with a minimum of force, traction must be made in the axis of the parturient canal.

2. *Compressor.*—In normal labor the head is elongated and moulded as it descends by the resistance of the pelvis and the soft parts. During forceps delivery a similar compression and moulding take place. While the head is being pulled through the resistant canal it dilates the passages as it advances and at the same time is compressed by them. When traction is applied compression begins; when traction is stopped compression ceases. The amount of compression is directly proportional to the amount of tractile force employed. As undue compression imperils the child's life, it is obvious that too much tractile force is dangerous for the child and should therefore be avoided. Long-continued compression is more apt to be injurious than intermittent compression, and a child may safely bear a greater amount of compression applied intermittently than if it is applied continuously. It is evident, therefore, that in the interests of the child traction should be gentle and intermittent, not forcible and continuous. Compression also may be made by the direct action of the blades. When the handles are long, as in the French forceps, the head can be compressed powerfully by forcibly pressing the handles together, since the leverage is good; but when the handles are short, as in the English instruments, there is little leverage, and consequently only feeble compression. Some forceps are fitted with a screw by which the blades can be brought together so forcibly as to ex-

ert powerful compression upon the head. Such contrivances are dangerous, and should be used only in exceptional cases. The forceps is chiefly and primarily a tractor, not a cephalotribe. It is usually stated that the head may be compressed from .6 to 1.3 centimeters ($\frac{1}{4}$ to $\frac{1}{2}$ inch) without danger; however, this cannot be taken as an invariable rule, since a great deal depends upon the degree of ossification and mouldability of the head, as well as upon the rapidity and continuousness of the compression.

3. *Lever*.—The usefulness or the harmfulness of the lever action depends upon what constitutes the fulcrum. If the instrument be swayed violently from side to side, pivoting first upon one side of the pelvis and then upon the other, delivery may be effected rapidly, but the maternal soft parts will surely be bruised between the forceps-blades and the pelvis; but if the forceps be used as a double lever, as recommended by Barnes, each branch being made to act alternately as a fulcrum for the other, a gentle oscillating movement of the head will be produced, and less tractile force will be required than if a straight pull be employed. A box or a barrel may more easily and safely be moved along a narrow passage by tilting or canting it from side to side: so, too, the fetal head may be drawn through the narrow curved parturient canal more easily and safely by a gentle to-and-fro lever movement than by a straight, steady pull. It is important to remember that this pendulum movement must not be used *alone*, but always while traction is being made; it is meant to supplement traction, not to replace it. Some operators use the forceps as a lever of the first or third order. Pajot frequently adopted this plan; Dr. A. H. Smith of Philadelphia for many years taught and practised a similar method, using one hand as a fulcrum at the lock. Considerable strength and dexterity are required to use the forceps in this way, and there is always danger of the blades pivoting upon the under surface of the symphysis or the arch and injuring the soft parts.

4. *Rotator*.—If there be used a good model which has not too great a pelvic curve, and if traction be made properly, the head should rotate in the normal way as it descends. If the handles be held too firmly, the head is apt to be dragged straight through without rotation; but if traction be made upon the shoulder or the ring of the instrument at the level of the lock, the handles being left comparatively free and not tightly grasped by the hand, the forceps will seldom interfere with the natural mechanism of rotation. In the one case the forceps determines the way in which the head shall descend; in the other case the head descends according to the natural mechanism and carries the forceps along with it. Some operators use the forceps to rotate the head artificially for the purpose of correcting faulty positions. Such a practice is dangerous, and should not be attempted by any one who is not sure of his diagnosis, possessed of wide experience, and expert in obstetric manipulation. It is generally safer to allow the head to rotate naturally as it descends; but if artificial rotation is to be done, the straight forceps should be used in preference to the double-curved instrument (see p. 456).

Indications.—The forceps may be applied to the presenting head, the after-

coming head, or the breech. If the head is presenting, it should be engaged in the pelvis, it should be of normal firmness and proportionate in size to the parturient canal, and there must be no mechanical obstacle to delivery necessitating the use of great force to overcome it. The membranes should be ruptured and the os should be dilated or dilatable. The operation is indicated—(1) In lingering labor when the natural efforts are unable to effect delivery; (2) when speedy delivery is imperative in the interest of the mother, as in hemorrhage, convulsions, exhaustion, advanced cardiac or pulmonary disease etc.; (3) when speedy delivery is indicated in the interest of the child, as in impending death of the mother or threatening asphyxia of the child.

The Operation.—Ever since the days of Smellie and Levret there has been a keen controversy respecting the best method of applying the forceps. Smellie formulated the rule that the blades should always be applied to the sides of the child's head, so that it may be grasped in the biparietal diameter. Levret adopted Smellie's rule. Saxtorph of Denmark (1740–1800), a pupil of Smellie, criticised this method, and advocated the application of the blades to the sides of the pelvis, regardless of the position of the child's head. He argued that the pelvic curve was added to accommodate the forceps to the natural curve of the pelvis, and that its maximum advantage is obtainable only when the two curves exactly coincide. Any divergence between them is accompanied by loss of advantage from the pelvic curve. His teaching had many followers until Baudelocque's powerful advocacy of the old Smellie method re-established it as the rule of practice on the Continent. In England, Ramsbotham, Simpson, and Barnes have done much to abolish the use of short forceps; as these instruments have disappeared Smellie's method has gone too, and Saxtorph's rule is now generally adopted. It is very curious that, although the application of the blades to the sides of the head originated in England, it has been replaced in that country by the old Continental method of application to the sides of the pelvis; while on the Continent the old Saxtorph method has been abandoned for the original Smellie method of application to the sides of the head. At the present day, therefore, we find two distinct methods in use, one adopted by the English, the other by the Continental school. The English apply the blades to the sides of the pelvis, regardless of the head; Continental obstetricians apply them to the sides of the head, regardless of the pelvis. The English method is simpler, easier, and less likely to injure the maternal passages; the Continental method is more complicated and difficult, but less likely to injure the child's head. On the whole, it is safer and better for beginners to learn and practise the English method; when they become more experienced and expert they may sometimes find the Continental method preferable.

The forceps operation is divided into the *high*, the *medium*, and the *low* operation. It is called *high* when the head is at or in the brim, but has not yet descended into the excavation; *medium*, when the head has passed the brim and entered the excavation, but has not yet come down upon the pelvic floor; *low*, when the head is pressing upon the floor and presenting at the outlet. When we say that the head is at or in, but not through, the brim, we mean that

its widest plane (the biparietal) is at or in the plane of, but has not yet passed through, the brim. The higher the head the more difficult and dangerous the operation. The low operation is generally easy and safe for both mother and child; the medium is harder, but not usually dangerous to either; the high operation is difficult and dangerous, and should be attempted only in exceptional cases. The tendency of modern practice is to limit very much the field of the high operation. Pinard insists very strongly that forceps should not be used to overcome osseous resistance, whether at the brim or at the outlet. Version and symphysiotomy are then safer alternatives. The method of applying forceps in the low and medium operations is practically the same, and will be described first.

Position.—In England it is customary to confine in the left lateral position; on the Continent and in America the dorsal position is generally preferred. In the latter position the blades are more easily applied; in the former extraction is easier and safer. A very good plan is to combine the advantages of both positions by applying the blades in the dorsal position and then turning the patient into the left lateral position for delivery.

General Preparations.—Before beginning the operation the bladder and the rectum should always be emptied, the vagina should be douched thoroughly with a hot antiseptic solution, and the vulva should carefully be washed and scrubbed. The operator's hands, the instruments, and everything which may come in contact with the parturient canal should, of course, be made aseptic. Lubricants are unnecessary if the hands and the instruments are dipped in a creolin solution; soap is preferable to oil or vaselin if creolin is not at hand. It is well to provide plenty of boiled water, both hot and cold, and to place within easy reach a basin of warm water for rinsing the hands, and another of creolin for use during the operation, as well as jute or absorbent cotton to cleanse the vulva, perineum, and anus. The bed should be protected with a clean mackintosh sheet, and a suitable receptacle should be arranged to catch the discharges. Anesthesia should always be used unless specially contra-indicated, for it not only saves the patient much pain, but also makes the operation easier and diminishes the risk of injury to the parturient canal; if possible, the management of the anesthetic should be entrusted to a competent assistant.

Operation in the Dorsal Position.—The patient is placed across the bed, with the head supported on a pillow, the hips well over the edge of the bed, the thighs everted, and the feet resting on a couple of chairs. Some operators prefer placing the patient in the lithotomy position, the knees being supported and steadied by a couple of assistants. The operator sits in front of the patient, between the everted thighs. The lower blade of the forceps is passed first into the left side of the pelvis, then the upper blade is passed into the right side; when properly adjusted, the blades are locked and extraction is begun. To introduce a forceps-blade properly both hands are used, one to pass the blade, the other to guide it up to and around the head. The *lower* blade is passed by the *left* hand into the *left* side of the pelvis, while the fingers of the right hand guide it internally; the *upper* blade is passed by the *right* hand into the *right*

side of the pelvis, while the fingers of the left hand guide it internally. To make sure of the proper blade, it is always well, before introducing the blades, to lock them and hold them with the pelvic curve looking upward, and then

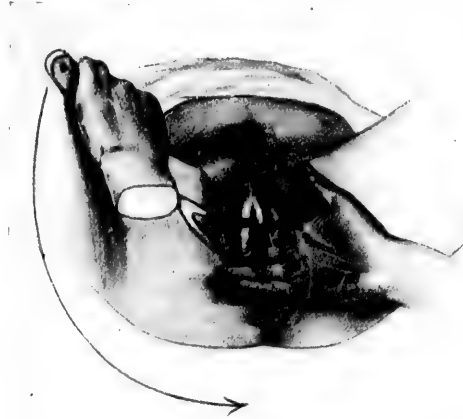


FIG. 488.—Method of lightly grasping and placing the lower blade for application; the arrow shows the arc followed by the handle as the blade passes upward.

select the lower blade. The lower blade, beak upward, is held lightly in the left hand, with the knuckles up, the thumb upon the flat of the handle, and

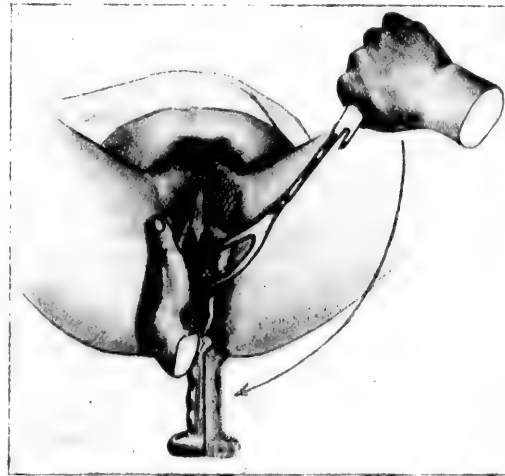


FIG. 489.—Beginning application of the second or upper blade. The handle follows the direction of the arrow to reach the position shown faintly near the first blade in place.

four fingers upon the outer portion, as shown in Figure 488. No force is needed to pass the blade; it is slipped along the fingers of the internal hand, and is guided by them around the convexity of the head; the handle is then

swept downward along the internal surface of the mother's left thigh, and the blade passes easily into position between the head and the left lateral wall of the pelvis. Then the upper blade, held in the right hand in similar fashion, is passed along the fingers of the left hand, well up around the head-globe, and the handle is swept downward along the mother's right thigh into its proper position in the right side of the pelvis (Fig. 489). If the pelvic curve of the instrument corresponds with that of the pelvis, the handles should be horizontal, looking one to the right thigh and the other to the left. The handles are then depressed, and by gentle manipulations are maneuvered into locking without the exercise of any force. Care should always be taken not to include hair or the labia in the bite of the lock. When the blades lock easily, it is usually considered that the case is suitable for the forceps operation. The proper

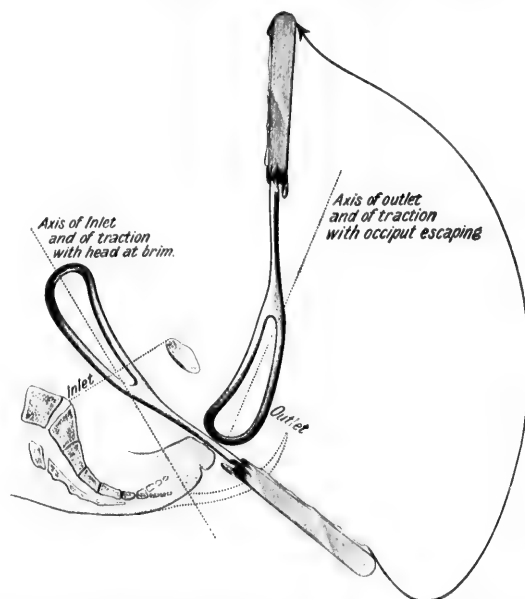


FIG. 490.—Axis of traction in the high operation corresponding with the axis of the inlet. Direction of the traction, as the forehead escapes, is nearly at right angles to the long axis of the mother's body. The arrow follows the course taken by the end of the handle.

management of the internal hand greatly facilitates the introduction of the blades; in fact, much of the difficulty experienced by beginners in introducing the blades is caused by failure to use the internal hand properly. To guide the lower blade into position, two fingers of the right hand should be passed along the left lateral wall of the vagina into the cervix and be pushed up as high as possible upon the left side of the presenting head-globe; then, with the finger-tips pivoting upon the head, the back of the fingers and the hand should be made to press the cervix, vagina, and vulva as far as possible toward the left. The forceps-blade can then easily be slipped along the palmar aspect of the fingers well up over the convexity, whence it glides around the head without

difficulty and with little or no expenditure of force. The commonest error is the failure to pass the fingers of the internal hand far enough and to press the cervix and vagina sufficiently to the left. In passing the upper blade (Fig. 489) the fingers of the left hand are passed into the cervix in a similar manner, and the lateral walls are pressed as far as possible toward the right. In

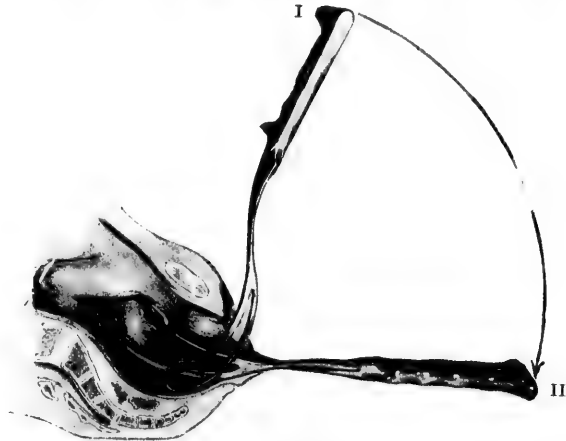


FIG. 491.—Low forceps application; side view of the application of the second blade: I., blade started; II., blade in position and forceps locked.

the low operation, if the head has emerged from the uterus and the cervix has retracted, the introduction of the blades is much easier, as the cervix need no longer be considered (Fig. 491).

After the blades have been locked slight traction should be made, to determine whether the head is firmly seized by the forceps, and whether any portion



FIG. 492.—Horizontal traction on a head which is beginning to distend the pelvic floor, the occiput being under the pubic arch.

of the cervix or membranes has been included in its grasp. Extraction is then effected by pulling steadily or with a slight pendulum movement in the axis of the pelvic canal. Some authorities utterly condemn the pendulum movement, and insist that the straight pull is always safer (Fig. 492). In the high operation the handles must be pressed back against the perineum as far as

possible (Fig. 490), to make the line of traction correspond with the axis of the brim; as the head descends the traction becomes horizontal (Fig. 492), and is finally directed upward (Fig. 493) as the head distends the perineum and emerges from the vulva. In the medium and low operations the line of traction is not so far backward. If the pains are strong, traction should be made during a pain and intermitted during the interval; but if the pains are feeble or absent, traction should be made for a minute or two and then be stopped, so as to avoid the dangers of too forcible compression of the fetal head and too rapid dilatation of the parturient canal. Too speedy delivery endangers the child's life and exposes the mother to the risks of laceration and hemorrhage. In the high and medium operations it is a good plan to keep the left index finger upon the presenting part during traction (Fig. 494), to determine whether traction is being made in the right direction and whether the head is descending and rotating properly or is being too forcibly compressed. If the head rotates as it descends, the forceps will rotate along with it, and the handles will turn from



FIG. 493.—Upward traction when the occiput has passed the pubic arch and the pelvic floor is on the stretch.

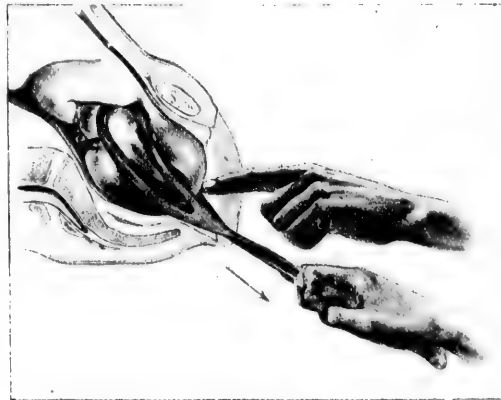


FIG. 494.—Finger determining direction of traction and amount of rotation and descent.

the horizontal position into the oblique or the antero-posterior; the blades should be unlocked and readjusted before the antero-posterior diameter is reached, or injurious pressure may be made upon the vestibule and urethra

in front or the perineum and rectum behind. Sometimes the blades require to be readjusted several times before delivery is completed.

Should the blades be removed before the head is completely delivered? Opinions are divided on this point. Those who favor non-removal claim that the forceps gives the operator greater control over the head as it comes through the vulva, and enables him to flex or extend it at pleasure, or hold it back if a violent pain drives it down too suddenly upon an insufficiently dilated perineum. Those who favor the removal of the blades claim that thereby a certain amount of room is gained, and the vulva does not need to be so much distended to permit the passage of the head; moreover, the head can more safely be piloted beneath the pubic arch by the hand than by the forceps. Upon the whole, better results are obtainable if the blades be removed when the head has descended sufficiently to bring the chin to the tip of the coccyx. They should be removed slowly during an interval between the pains, and in the reverse direction from that in which they were introduced.

In forceps operations, when the head descends in the transverse diameter and does not rotate forward, the blades should always be removed as soon as the head reaches the muscular pelvic floor. Non-rotation is apt to occur in flat or funnel-shaped pelvises, or when the fetal head is large and the occiput wide. In such cases the head may become impacted in the pelvic outlet, whence it cannot be dislodged by the natural efforts, and the child may perish, or the maternal passages may slough from pressure if the application of forceps be too long delayed. Before resorting to forceps, however, the patient should be anesthetized and an attempt made to rotate the head by means of two fingers passed up behind the ear which lies close to the symphysis, as recommended by Tarnier. This manœuvre will probably fail in cases of contracted pelvis. Care having been taken to promote flexion, the forceps-blades should be applied to the sides of the pelvis and traction made until the head reaches the muscular floor, when they should be removed. The head can then be rotated by means of two fingers placed on the posterior fontanelle, the forehead being pressed backward by two fingers of the other hand. If the head be dragged through the outlet in the transverse diameter, extensive laceration will certainly take place. Some operators prefer the oblique application of the forceps; others attempt to rotate the head by means of the forceps. The latter practice is dangerous and should be avoided if possible.

The High Operation.—Opinions are divided as to the indications for the high operation. Some operators claim that in certain emergencies the forceps may be used even if the head is not yet engaged in the brim; others hold the operation to be unjustifiable until the head is well engaged; while others, again, insist that the largest diameter of the head shall have passed the brim before forceps can safely be applied. There can be very little question of the great danger to both mother and child if the head is not well engaged in the brim; under such circumstances version is safer and better. But when the head is well engaged and there is no disproportion between it and the pelvis, and the os is fairly dilated or dilatable, there need be no serious risk to the mother

or the child. The chief danger to the child is from compression during the prolonged and sometimes forcible traction which may be required to overcome the resistance of the maternal soft parts. The danger to the mother is from laceration and bruising of the lower uterine segment, the cervix, and the vagina during extraction. However opinions may differ as to the proper way of applying the blades in the medium and low operations, there can be no doubt that in high operations it is best to apply them to the sides of the pelvis without regard to the position of the child's head. As the head usually engages in the brim either in the transverse or the oblique diameter, it will be grasped by the forceps antero-posteriorly or obliquely. If antero-posteriorly, one blade will

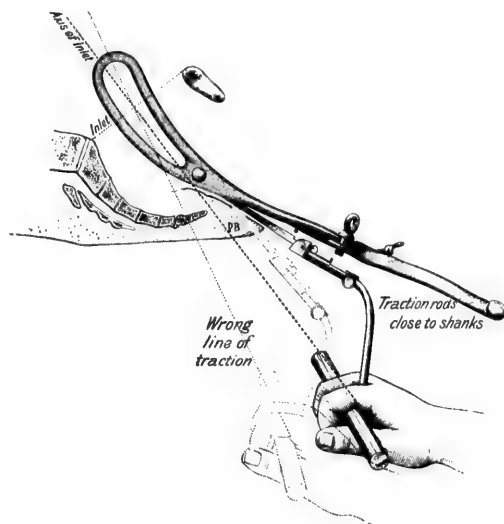


FIG. 495.—Diagram showing the right and wrong methods of pulling on the handle-bar, and that the line of traction is directly in the axis of the inlet (much modified from Ribemont).

be over the forehead and the other over the occiput; if obliquely, one will be over a parietal protuberance and the other over the opposite coronal suture. During traction the forceps is liable to slip and to wound the soft parts unless the handles are well compressed; or the flexion of the head may be impaired and extraction be made more difficult. It is of the utmost importance that traction should be made in the axis of the pelvis to minimize the amount of traction force employed. The axis-traction forceps has been devised for this purpose. With the ordinary forceps more or less force is wasted against the symphysis, with the result that the maternal tissues are bruised and the fetal head is needlessly compressed. A glance at Figure 495 will show the advantage of axis-traction at the brim and the impossibility of securing it with the ordinary forceps. Another great cause of difficulty and danger in the high operation is

the imperfect dilatation of the os and the resistance offered by the cervix. If the operator attempts to overcome this by sheer force, he will most probably need to use an amount of traction that will prove dangerous to mother and child. It is better to overcome cervical resistance by artificial dilatation before the forceps is applied than by main force afterward. If there is no time for artificial dilatation, the cervix should be incised; *accouchement forcé* is now rarely justifiable. By the use of axis-traction forceps and artificial dilatation of the cervix the high-forceps operation may be shorn of its chief dangers. Extraction should not be hurried, but plenty of time should be allowed for the moulding of the head and the dilatation of the soft parts. The axis-traction forceps offers no advantages at the pelvic outlet, while it takes up more room; many operators remove it when the head comes down upon the perineum, and complete the delivery with a lighter and less bulky instrument.

In Occipito-posterior Positions.—When the occiput is directed posteriorly, the case should be left to nature so long as possible, in the hope that forward rotation may take place. Some authorities recommend in such cases the use of forceps to turn the occiput forcibly to the front. Such a manœuvre rarely succeeds; it is capable, moreover, of seriously injuring the child by rotating the head upon the trunk more than it is safe to do. But if the natural efforts fail, or there is need for speedy delivery, the forceps may be applied and simple traction be made. Natural rotation may still take place, but if it does not the head may safely be delivered in the occipito-posterior position. The blades

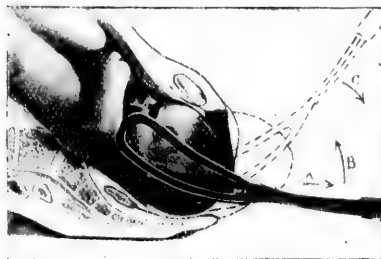


FIG. 496.—Forceps extraction in persistent occipito-posterior position: A, initial line of traction; B, direction in which forceps-handles are lifted; C, direction of forceps, after occiput has escaped, in order to deliver the face.

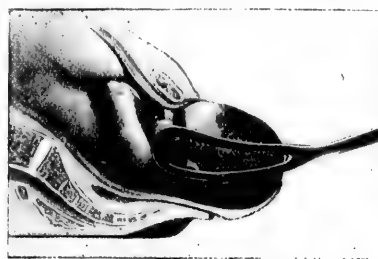


FIG. 497.—Over-distention of the perineum in persistent occipito-posterior deliveries; the nose rests under the pubic arch.

are applied as in the ordinary low operation, and they adapt themselves usually to the sides of the child's head, since the long diameter is nearly or quite in the antero-posterior diameter of the pelvis. In using traction the natural mechanism of delivery in this position should be borne in mind and the forceps be used merely to aid nature. The head becomes arrested in the pelvis because it has undergone extension; therefore, as Barnes aptly puts it, the essential thing to do is to get the occiput down—that is, to restore flexion.

Traction is made downward or horizontally until the forehead emerges sufficiently for the root of the nose to pivot beneath the pubic arch (Figs. 496, 497); the handles are then raised in order to roll the occiput out over the

perineum, and they are then finally depressed to deliver the face and the chin beneath the pubes. If upward traction is made too soon, the blades will be apt to slip off. Extraction should not be hurried, but plenty of time should be allowed for the moulding of the head and the dilatation of the perineum. The bulky occiput distends the perineum more than does the forehead in occipito-anterior deliveries (Fig. 497); hence more time should be given the perineum to stretch, and special precautions should be taken against rupture. With proper care and attention forceps delivery in occipito-posterior positions should not be much more difficult or dangerous than in ordinary low operations (see also p. 453).

In Brow and Face Presentations.—Brow presentations usually flex into vertex or extend into face presentations as the head descends into the pelvis. Forceps should not be applied early in face presentations, but ample time should be allowed for the natural mechanism of forward rotation of the chin. When the face is presenting at the brim, version is preferable to forceps, if manipulation has failed to convert the face presentation into one of the vertex. When the face is descending transversely, forceps should not be used, for traction would be dangerous from pressure on the neck and thorax. When the chin is pointing posteriorly the forceps is contra-indicated; but if the chin has rotated anteriorly and the natural efforts are insufficient to complete delivery, the forceps may be used with advantage. The blades should be applied as nearly as possible to the sides of the child's head, and far enough back to give a good grasp of the occiput (Fig. 498). Traction is made downward until the chin has been brought fairly under the pubic arch; it is then directed gradually forward, and finally upward, as the forehead and occiput sweep out over the perineum. Delivery should be slow after pivoting takes place, because the perineum becomes enormously distended and is apt to tear deeply. Some operators use the forceps to correct faulty positions and to rotate the chin forcibly to the front. Occa-

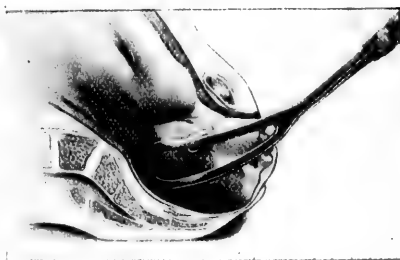


FIG. 498.—Forceps extraction in a face presentation: the chin has passed the arch, and appears at the vulva, while the face is still distending the pelvic floor.

sionally such manipulations may succeed, but they are always fraught with danger. If an early diagnosis is made by external palpation, there is no good reason why a face presentation should not be converted into a vertex one by external manipulation if the patient be deeply anesthetized; but if rectification is impossible, version is usually easy, and is far preferable to a forceps operation. If labor has gone on for some time, and the head is too low down for rectification or version, the claims of symphysiotomy should be considered. In such a case, if the symphysis be divided the faulty position can be rectified and the head be delivered with less traction, and therefore less compression, while the

maternal soft parts are less exposed to serious bruising and laceration. External palpation, external rectification of faulty positions, and the modern symphysiotomy have greatly altered the old ideas respecting forceps operations and have vastly improved the results (see also p. 462).

In Breech Presentations.—In certain difficult breech presentations, when it is impossible to bring down a foot, the forceps sometimes succeeds. When the limbs are extended and the feet are on a level with the shoulders (*mode des fesses*) the forceps proves particularly serviceable. Tarnier's axis-traction forceps gives a better hold than the ordinary forceps and is less liable to slip, since it enables traction to be made more certainly in the pelvic axis. The



FIG. 499.—Forceps extraction of the after-coming head: the arrows show the direction of traction.

blades should be applied over the trochanteric or bisiliac diameter, in order that the pelvis may be grasped as nearly as possible transversely (Fig. 278, p. 479). If applied otherwise, the blades are apt to slip, causing injury to the fetal abdomen and genitals. Traction should always be made gently and in the pelvic axis; the pendulum movement is to be avoided. Care should also be taken not to compress the blades too forcibly, for fear of fracturing the iliac

bones. The forceps, properly applied, will injure the child far less than the fillet or the blunt-hook (see also p. 478).

To the After-coming Head.—In breech cases, when there is difficulty in delivering the head quickly enough to save the child's life, the forceps is sometimes of great use as a *dernier ressort*. In such cases it is a question whether the head can be delivered soon enough to prevent the child from asphyxiating, not whether it might not possibly be delivered after a time by some other means. When ordinary measures have failed and the child's life is in imminent danger, the forceps should be tried. The old rule is to apply the blades along the child's abdomen; if the occiput is to the front, the child's body is lifted up over the pubes and the blades are applied to the head from beneath (Fig. 499); if the face is to the front, the child's body is carried back

over the perineum and the blades are applied from above. Traction is made in the direction that will secure speediest delivery. It will sometimes be found more convenient to reverse the rule and to apply the blades along the child's back, especially if the perineum is very long and rigid. The best plan is to apply the blades wherever there is most room. The application of forceps to the after-coming head is the only means of saving the child when the cervix has retracted about the neck and resists all efforts to deliver by traction upon the body.

To the Severed Head.—When decapitation has been performed, it is sometimes difficult to deliver the head. If an assistant brings the head down over the brim and holds it firmly there, the operator can generally pass his hand into the uterus and guide the blades over the head until they grasp it securely. Care must be taken that no spicules of bone protrude to lacerate the parturient canal during extraction.

Application of Forceps in the Left-lateral Position (English Method).—The patient is placed across the bed, lying on her left side, with both knees drawn

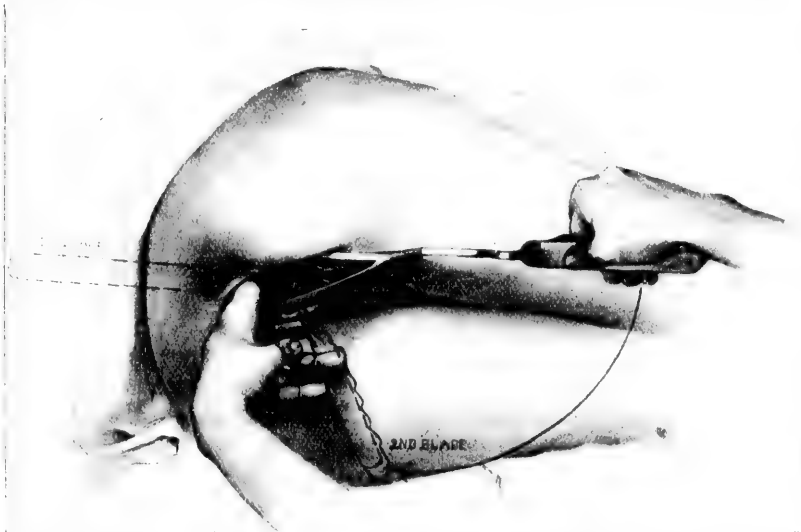


FIG. 500.—Application of the forceps in the left lateral position: the arrows show the course taken by each blade.

up and the hips brought well over the right edge of the bed. Both blades are passed with the right hand, while the left guides them around the head. Two fingers of the left hand are passed along the posterior wall of the vagina (Fig. 500), through the cervix to the presenting part, and are pushed up as far as possible. With the finger-tips pivoting upon the head-globe, the backs of the fingers and the back of the hand press back the cervix, the posterior vaginal wall, and the perineum as far as the coccyx will permit. The lower blade, held in the right hand with the beak downward and the cephalic curve directed forward, is

passed horizontally along the guiding fingers of the left hand until its tip is directed over the convexity of the head-globe. The handle is then raised and carried backward along the mother's right thigh, which movement causes the point of the blade to travel around the *under* surface of the head-globe. Finally the handle is carried backward and downward until the shank falls behind the operator's left wrist, which keeps the blade from shifting during the passage of the second blade. An assistant is not required to hold the first blade, as in the dorsal operation. The upper blade, held in the right hand in precisely the same way as in the dorsal operation, is then passed horizontally along the guiding fingers of the left hand, above the shank of the first blade, until the fingertips direct it over the convexity. The handle is then lowered and carried backward along the mother's left thigh; this movement causes the blade to travel around the *upper* surface of the head-globe until it lies in the right ilium. The left hand is then withdrawn from the vagina, and a handle is seized in each hand. The handle of the first blade is made to retrace its course a little until it lies directly over the second blade; with a little maneuvering the blades can easily be locked if the case is suitable for the forceps operation. When the blades are locked one handle should look vertically upward, the other vertically downward. When extraction is about to begin the handles are carried well back against the perineum in order to make traction approximately in the axis of the brim. As the head descends the handles are carried more and more forward. The introduction of the blades is somewhat more complicated than in the dorsal position, but in extraction the lateral position has the great advantage of enabling the operator to estimate more accurately the line of traction, and to modify it more easily as circumstances may require. During extraction in the dorsal position the handles describe a vertical arc from below upward; in the lateral position they describe a horizontal arc from left to right.

The amount of tractile force can better be graded, and the line of traction can more easily be kept in the pelvic axis, when the operator is pulling around the horizontal arc of the lateral position than when pulling at a disadvantage around the vertical arc of the dorsal position. As the tendency is generally to pull too much and too soon to the front, and as modern beds are low and the patient's pelvis is usually on a lower level than the arms of the operator, the dorsal position is apt to increase the tendency to pull too much to the front. A certain amount of force is consequently wasted against the front wall of the pelvis, and more force is required to effect delivery than if the pull had been in the proper direction; moreover, the perineum is more fully in view throughout the operation, and can more easily be safeguarded, than in the dorsal position. In private practice the lateral position is often more convenient, since a skilled assistant is not required. On the contrary, the dorsal position permits the use of pressure on the fundus to supplement the operator's tractile force, and there is less loss of power from want of coincidence of the uterine and pelvic axes. Each method has its advantages as well as its disadvantages; in some cases it may be more convenient to use one, and

in some the other method, or even occasionally to change from one to the other during the course of the operation.

Symphysiotomy (σύνφυσις, symphysis, τομή, a cutting) is an operation for division of the pubic symphysis. Its object in obstetrics is the enlargement of the pelvic cavity to facilitate delivery in narrow pelvises.

History.—The first symphysiotomy of which we have any knowledge was performed in 1644 by Jean Claude de la Courvée, a French physician practising in Warsaw, Poland. This operation was performed after the death of the mother for the purpose of saving the child. A similar post-mortem section was performed in 1766 by Joseph Jacques Plenck of Hungary. To Jean René Sigault of Angers, France, belongs the credit of originating the operation as applied to the living subject. The idea seems to have been suggested to him, however, by a work of Severin Pineaud, first published in 1598. While still a student of medicine, Sigault had several times practised the operation of symphysiotomy on the bodies of women who died in labor, and in 1768 he read a memoir upon the subject before the Royal Academy of Surgery at Paris, proposing the division of the pubic joint as a substitute for Cesarian section. His proposal for a time met with little favor, since his first experiments, which were performed on bodies that had become rigid from being too long dead, failed to show an amount of separation sufficient to effect any material gain in the pelvic diameters. The first operation on the living woman was performed Oct. 1, 1777, by Sigault, with the assistance of Prof. Alphonse Leroy, who had become interested in the subject, and in common with Sigault had studied the operation on the cadaver. The woman's recovery was tedious and complicated with a urinary fistula, yet both mother and child survived. At this time Cesarean section was almost uniformly fatal, and the new operation, which seemed destined to replace it, was received with enthusiasm. In the next decade thirty-five symphysiotomies were done in various parts of Europe. Imperfect knowledge of pelvimetry and of the proper limits of the operation led to its frequent misapplication; the technique, too, was faulty. Urethral and vesical injuries, sepsis of the pelvic organs, caries of the bones, and non-union of the joint were frequent results of the operation, and it soon began to lose favor. Symphysiotomy was bitterly denounced by Baudelocque and certain other obstetric authorities of the time, and in 1858 it had fallen into general disrepute. During the period between 1777 and 1866 there were, according to Harris, one hundred symphysiotomies, with a maternal mortality of 31 per cent. and a fetal mortality of 65 per cent. From 1818 to 1891 symphysiotomy was almost exclusively confined to Naples. Though it at no time wholly died out, it was practically obsolete from 1858 to 1866. In the latter year it was taken up by Prof. Ottavio Morisani of Naples, who first operated in January, 1866, saving both mother and child. Encouraged by this success, he became deeply interested in the cause of symphysiotomy, and to his labors in its behalf we are indebted for its general re-adoption. Largely as the result of his efforts the technique was improved and the mortality greatly reduced. The first fifty Neapolitan operations done by Morisani and his fol-

lowers saved 80 per cent. of the mothers, and later, when the operation came to be performed under modern antiseptic methods, the mortality was still further diminished. The results were frequently published, yet for a quarter of a century the successful work that was being done in Naples attracted little or no attention outside of Italy. Until 1892 the operation was almost universally condemned or was ignored by obstetric writers in other parts of the world. That year was a memorable one in the history of symphysiotomy. In January, 1892, it again secured a footing in Paris. At that date Spinelli, a pupil of Morisani, published in the *Annales de Gynécologie* a memoir with a detailed account of twenty-four cases. Moreover, Pinard, the editor of the journal, had seen the operation demonstrated upon the cadaver by Spinelli. He at once became an earnest champion of symphysiotomy, and recommended it in a paper upon the subject before he had performed it. He first operated in February, 1892, and in little more than a year nineteen symphysiotomies were performed by himself and his assistants, saving nineteen women and sixteen children. Within a few months after the publication of his first successes the operation had spread to the rest of the Continent and over both hemispheres.

In the United States, Dr. Robert P. Harris of Philadelphia had long upheld the cause of symphysiotomy, and had repeatedly brought the subject to the attention of the English-speaking profession. In September, 1892, he presented a paper to the American Gynecological Society entitled "The Remarkable Results of Antiseptic Symphysiotomy."¹ From this time dated the introduction of symphysiotomy into America. On the 30th of September, 1892, the operation was performed by the writer, and three days later by Prof. Barton C. Hirst of Philadelphia. Other operations followed in rapid succession in various parts of the country.

Results of Symphysiotomy.—In 210 symphysiotomies performed since 1886, when the operation began to be done under Listerian precautions, there were, according to Neugebauer,² 27 maternal deaths, a mortality of 12.85 per cent. Of the children 20.2 per cent. were lost, including those that died shortly after birth. Under favorable conditions, however, and at the hands of skilled operators, the death-rate has been almost *nil*. Pinard lost but one mother in his first 20 operations, and Zweifel none in his first 23—one death in 43 cases.

In the first 72 operations in the United States the maternal death-rate was 14 per cent. and the infantile mortality was 26 per cent. But these results cannot be taken as fairly representing the capabilities of symphysiotomy. The operations were done by a large number of operators of varying degree of skill and for the most part of little or no experience in symphysiotomy. In many cases the conditions were unfavorable for pubic section, and most of the deaths were due to causes wholly independent of the method of delivery.

In Italy, at the hands of Morisani and his followers, in 55 modern symphysiotomies 3.5 per cent. of the mothers and 5.5 per cent. of the children

¹ *American Gynecological Transactions*, vol. xvii.

² *Ueber die Rehabilitation der Schamfugentrennung oder Symphyseotomie*, etc., 1893.

were lost. Pinard of Paris in his first 20 operations had but one maternal death. The total number of cases in the Baudelocque clinic (1892-94) was 49; four women and five children died. Zweifel of Leipzig operated 23 times, saving all the mothers and all but two of the children. It would seem that in properly selected cases and with skilled operators the death-rate for the women should not, at the most, exceed three or four in a hundred.

In the proportion of mothers saved the record of symphysiotomy compares favorably with that of Cesarean section. In 79 Cesarean operations performed in the United States since the adoption of the Sanger method, 35.49 per cent. of the mothers and 12.69 per cent. of the children were lost. Zweifel's results in 23 symphysiotomies with no maternal deaths and Morisani's 55 cases with a loss of 3.5 per cent. of the mothers have not been equalled by Cesarean section. In the best Cesarean record, which is that of Leipzig, three women were lost in 54 operations—a mortality of 5.5 per cent. The proportion of children lost under symphysiotomy has greatly exceeded that of the Cesarean operation.

In premature artificial labor under approved modern methods the maternal death-rate should not be more than 2 or 3 per cent., but the mortality for the children is very great. Two-thirds of the children perish, if we include those who die within a few days or weeks after birth.

In the early history of symphysiotomy suppuration of the symphysis and of the sacro-iliac joints, caries of the pubic bones, and non-union were not infrequent results of the operation; but they were for the most part faults of the crude surgery of that period, rather than of the operation itself. In several recent cases some mobility of the pubic bones has been noted when the women began to walk, but rarely more than is occasionally observed after difficult forceps deliveries and even after spontaneous births. The woman's powers of locomotion are not necessarily crippled by slight looseness of the joint. Frommel, however, recently reported a case in which a sequestrum of bone an inch in length came away, and there was persistent failure of union with inability to walk after three months. As a rule, under a rigid asepsis, and with complete immobilization of the pelvis during convalescence, the restoration of the symphysis in women not previously infected has been complete. Vesical and urethral injuries have been reported in several instances. They are liable to occur not only from the knife, but also from pinching the urethra and bladder between the bones when the latter are brought together. These accidents, Morisani declares, are faults of the operator, and should be prevented. Troublesome hemorrhage frequently happens, either from the incision or from lacerations. It is especially liable to be encountered on division of the subpubic ligament, owing to the vascularity of the structures about the lower end of the symphysis. Lacerations of the corpus cavernosum of the clitoris, with more or less bleeding, not infrequently occurs. Hemorrhage, however, is controllable by use of pressure and the hemostatic suture. Packing the wound and the vagina with iodoform gauze generally suffices. The vagina, particularly the anterior wall, is exposed to laceration during the extraction of the child. In septic conditions of the passages the latter

injuries may assume no little importance by opening avenues for the possible infection of the symphysis. To what extent these complications may be prevented future experience must decide.

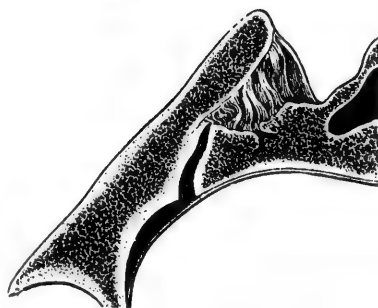
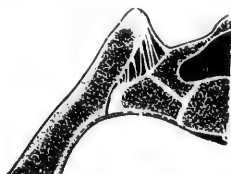


FIG. 501.—Separation of the sacro-iliac joint on opening the pubic symphysis (Farabeuf).

Anatomical Limitations.—The gain of space attainable in symphysiotomy is mainly determined by the mobility of the sacro-iliac joints (Fig. 501). Experiments on the cadaver by Wehlie and numerous other observers show that in non-puerperal pelvises the anterior sacro-iliac ligaments rupture at different degrees of pubic separation, ranging from about 4 to 9 centimeters ($1\frac{1}{2}$ to $3\frac{1}{2}$ inches), the results varying with the age and the physical condition of the subject. In pelvises from puerperal women a separation of 8, or even 9, centimeters is possible without injury to the sacro-iliac articulations. In two operations by Caruso an interpubic space of 8.5 centimeters ($3\frac{3}{5}$ inches) in one and 9 centimeters ($3\frac{3}{5}$ inches) in

the other was obtained with no bad results; 6.5 centimeters ($2\frac{3}{8}$ inches) may be regarded as an entirely safe limit of pubic separation. With an interpubic

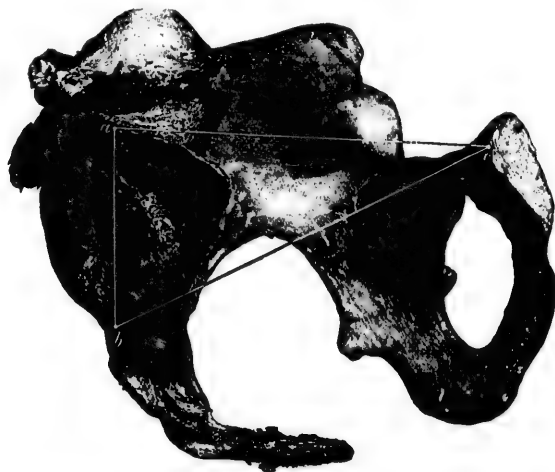


FIG. 502.—Left innominate bone: *a, b*, axis at the ilio-sacral joint upon which the bone rotates when the pubic end is abducted (Wehlie).

opening of 6 centimeters ($2\frac{3}{8}$ inches), the conjugata vera gains 1.2 centimeters ($\frac{1}{2}$ inch), the transverse 1.9 centimeters ($\frac{3}{4}$ inch), and the oblique diameters 2.5

centimeters (1 inch). With a separation of 7 centimeters ($2\frac{3}{4}$ inches), which is possible under gentle pressure without laceration of the sacro-iliac ligaments, the gain in the conjugata vera is 1.5 centimeters ($\frac{3}{8}$ inch).



FIG. 503.—Sacrum: *a b*, axes on which the innominate bones hinge. Owing to the wedge-shape of the sacrum, they run from above downward and inward (Wehle).

Wehle¹ called attention to the fact that when the pubic bones are separated the sacro-iliac joints rotate upon an oblique line running from above downward and from without inward, and that in consequence the ends of the pubic bones move downward as well as outward when the joint is opened (Figs. 502–

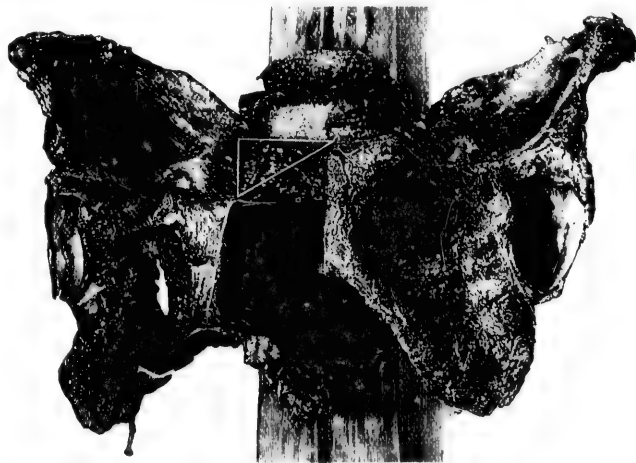


FIG. 504.—Moist preparation of pelvis attached by sacrum to a post; left innominate bone immobilized; right bone abducted. Shows downward movement of pubis on abduction (Wehle).

508). A separation of 3 centimeters ($1\frac{1}{2}$ inches) causes a descent of 2 centimeters ($\frac{3}{4}$ inch), which is still further increased by the downward pressure of the fetal head during delivery. This descent of the pubic bones adds mate-

¹ *Arbeiten aus der Königlichen Frauenklinik in Dresden*, Band i., 1893.

rially to the amount of pelvic space gained (Figs. 504, 505, 507). All the

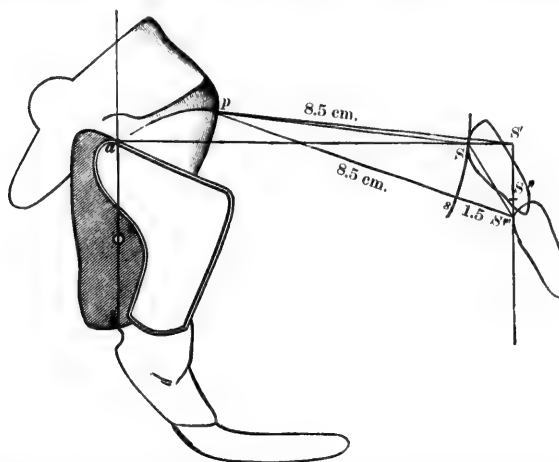


FIG. 505.—The effect of descent of the pubic bones on the gain in length of sacro-pubic diameter. By mere separation of bones, the gain in conjugata vera would be SS' ; with added effect of descent it is SS'' , SS''' (Wehle).

lines running from the promontory to the anterior half of the linea ilio-pectinea are elongated more than by mere separation of the pubic bones. But this is

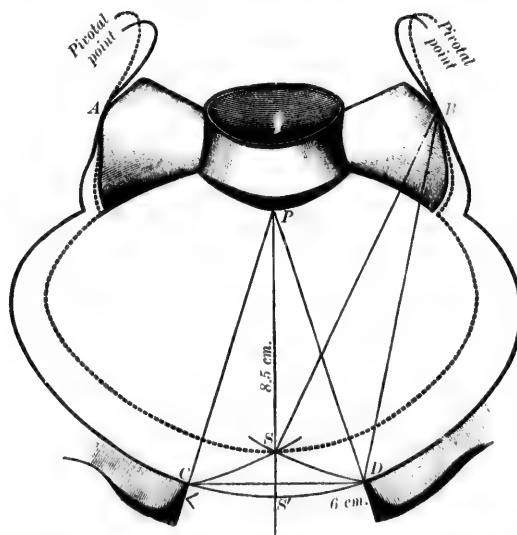


FIG. 506.—Diagram of pelvic brim, showing gain in space on opening pubic joint: PS , conjugate joint closed; PS' , conjugate joint open 6 cm. (Wehle).

not all. As the bones recede from each other the anterior parietal boss projects nearly a centimeter into the pubic interspace. The increase in the conjugate

diameter by opening the pubic joint to the extent of 6.5 centimeters ($2\frac{3}{4}$ inches) amounts, therefore, in effect, to about 2 centimeters ($\frac{3}{4}$ inch).

Indications.—In general, symphysiotomy is applicable in obstructed labor in which the delivery of a living, viable child may be rendered possible by a

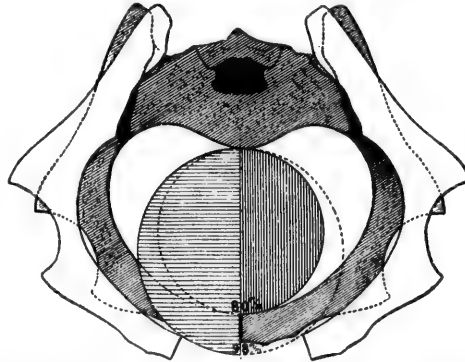


FIG. 507.—Diagram of pelvic brim, showing gain of space on separation of symphysis. Pubic joint closed, pelvic cavity admits a sphere 80 mm. in diameter; joint opened 6 cm., the cavity admits a sphere 98 mm. in diameter (after Farabeuf).

moderate expansion of the pelvis. In the simple flattened pelvis the limits of the operation may be computed from the data already considered. The biparietal diameter of the average fetal head is 9.5 centimeters ($3\frac{3}{4}$ inches). It is reduced by compression during the birth to about 9 centimeters ($3\frac{1}{2}$ inches).

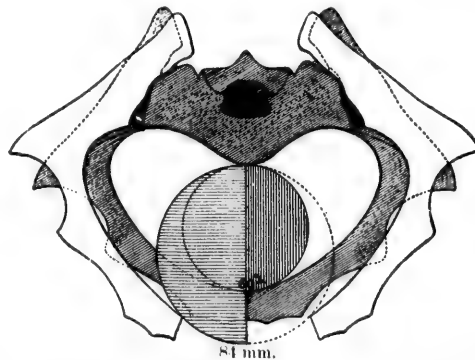


FIG. 508.—Diagram of pelvic brim, showing gain of space on separation of symphysis. Pubic joint closed, the pelvic cavity admits a sphere 60 mm. in diameter; joint opened 6 cm., the excavation admits a sphere 84 mm. in diameter (after Farabeuf).

After full separation of the symphysis the parietal boss projects into the interpubic space, and this in effect shortens the biparietal diameter to the extent of nearly a centimeter more. A conjugate of 8 centimeters ($3\frac{1}{5}$ inches) will therefore be required for the passage of the head. Since a pubic separation of 6 centimeters ($2\frac{2}{5}$ inches) affords a gain of 1.2 centimeters ($\frac{3}{4}$ inch) in the antero-

posterior diameter, delivery under symphysiotomy may be done in simple flat pelves with a conjugate not below 6.8 centimeters ($2\frac{3}{8}$ inches). Clinically, however, at least in America, 7 centimeters ($2\frac{3}{4}$ inches) is generally adopted as the minimum conjugate for pubic section.

At its upper limit the field of symphysiotomy begins where that of forceps and version ends. The latter operations become dangerous to mother and child in contractions below 9 centimeters ($3\frac{1}{2}$ inches), conjugata vera. Not only is the maternal and the fetal mortality greatly increased under prolonged and difficult extraction by forceps or version, but mental and physical infirmities, resulting from intracranial injuries, are also common in the children who survive. With a normal head, then, the field of symphysiotomy in simple antero-posterior contraction lies between 7 and 9 centimeters ($2\frac{3}{4}$ and $3\frac{1}{2}$ inches), conjugata vera. In generally-contracted pelves the operation may usually be performed with advantage with a conjugate between 8.2 and 10 centimeters ($3\frac{1}{4}$ and 4 inches).

The limitations of symphysiotomy, however, cannot yet be regarded as absolutely settled. Views differ according to the varying success of different operators. More extended experience will be required to determine fully the place which the operation shall finally hold in obstetric surgery.

It is evident that the safe choice of procedure must depend upon an accurate estimate of the relative size of the head and the pelvis, and this is possible only for the expert well trained in pelvimetry and the methods of measuring the fetal head. The capacity of the pelvis to receive the head should be judged not only by direct measurements, but also by trying whether the head can be crowded into the excavation or can be made to engage by careful traction with the forceps.

Symphysiotomy has been proposed for delivery in impacted and irreducible mento-posterior face cases and in occipito-posterior positions with impaction. In such emergencies and in irreducible brow presentations, provided all other conditions are favorable for both mother and child, pubic section would seem particularly applicable, since the small extent of pubic separation required would entail a minimum risk to the mother.

The symphysis has been opened to facilitate delivery by embryotomy on the dead child in absolute contraction of the pelvis. The combination of symphysiotomy and premature labor seems to the writer of doubtful utility. The object is to extend the limits of the former procedure into the higher grades of contraction, but the combined risks of both operations can scarcely offer any advantage over Cesarean section, especially for the child. Symphysiotomy is obviously contra-indicated in ankylosis of the sacro-iliac joints, and therefore in the Robert and the Naegele pelvis.

Method of Operation.—The instruments and materials required in symphysiotomy are a common scalpel, a slightly curved, narrow-bladed, probe-pointed bistoury, the Galbiati knife or the modified Galbiati knife of Harris, curved needles, needle-forceps, catgut and silk sutures, a few hemostatic forceps, a metallic catheter, and a yard or two of iodoform gauze. Three

assistants are needed—one to give the anesthetic, two to hold the knees and render such other assistance as the operator may require. The proper time for operation is at the close of the first stage of labor. In emergency the dilatation of the cervix when already well advanced may be completed by the hand or by the use of Barnes' bags. In certain cases advantage may be gained by dividing the symphysis before full dilatation in order to promote the expansion of the cervix by permitting the head to sink into the excavation. Immediately before the operation examination should be made for the auscultatory evidence of fetal life by listening over the abdomen. Before finally deciding upon symphysiotomy the mobility of the sacro-iliac joints should be tested by strongly flexing and extending the thighs and by rotating the knees outward. The patient is anesthetized and placed upon a firm table with her knees drawn up and held apart. The pubes should be shaved and the abdominal walls should be cleansed and disinfected as for celiotomy. The vulva and the vagina should be rendered as nearly aseptic as possible, since the pubic wound is exposed to infection through vaginal lacerations. The location of the symphysis is then determined by searching for the depression at its upper margin. The slight motion produced by raising and lowering the legs helps in finding the joint. It must be remembered that an exact central position of the symphysis is exceptional in deformed pelvis. The depth of the joint is to be noted and the surfaces are to be examined carefully. An assistant then introduces a straight metallic catheter for the purpose of holding the urethra and the vesical neck backward and to the right side during the division of the joint: this at the same time serves to keep the bladder empty. Either a short or a long primary incision may be adopted. In the former method, which is that pursued by Morisani, a vertical incision of from 2 to 3 centimeters ($\frac{3}{4}$ to $1\frac{1}{4}$ inches) in length is made in the abdominal wall, terminating below at a point 1 centimeter ($\frac{3}{8}$ inch) above the upper end of the symphysis. In the latter, or open method, the incision is made from 8 to 10 centimeters ($3\frac{1}{2}$ to 4 inches) in length, extending well above the symphysis and terminating below at the root of the clitoris or turning to one side of it. The principal gain in the short incision is the lessened danger of hemorrhage and of subsequent infection from the lochial discharge. The long incision, however, has the advantage that it enables the operator to see what he is doing at each step. The former is generally to be preferred. The incision may be prolonged and the joint exposed when found necessary for the control of hemorrhage or in consequence of other complications.

Morisani separates the attachments of the recti by cutting sideways sufficiently for the introduction of the finger. This practice offers no advantage and unnecessarily weakens the abdominal wall. The better practice is to make the opening in the aponeurosis between the recti longitudinally, extending down to the joint and large enough to admit the finger. The retropubic structures are separated by the index finger, which is introduced into the wound, carried down behind the symphysis, and hooked under the inferior ligament. Upon this finger as a guide the probe-pointed bistoury is passed

down behind the joint to the lower edge of the subpubic ligament. The joint structures are then divided, cutting from behind forward and from below upward until the bones are felt to give way. If the sickle-shaped knife of Galbiati or of Harris is used, it is hooked under the subpubic ligament and drawn upward and forward through the joint. During the incision the urethra is held backward away from the pubic arch and to the right by means of the metallic catheter in the hands of an assistant. Instead of the finger a Hays director may be passed behind the joint to guide the knife. The writer found no difficulty in passing the probe-pointed bistoury safely along the posterior surface of the symphysis, guided by a finger of the left hand in the vagina. If this method is attempted, the bistoury point should be made to hug the joint closely all the way. It may happen that the introduction of an ordinary bistoury behind the symphysis may be found difficult or impossible, owing to a pendulous abdomen. The joint can then be cut mainly from above downward. Pinard and others prefer to incise the symphysis from before backward. In this method of incision the retropubic structures should be protected by a tampon of iodoform gauze or by a lead plate placed behind the symphysis. The plan of cutting from before backward and above downward has been advocated, for the reason that the symphysis is wider at the upper than at the lower margin, and is wider anteriorly than posteriorly. There is usually little difficulty, however, in engaging the knife in any aspect of the joint. In rare cases, owing to the sinuous shape of the symphysis or to ossification of the joint, it has been found necessary to replace the knife with a chain-saw or a finger-saw. Rarely the head may be crowded so firmly into the excavation that it may be necessary to push it up before the symphysis can safely be divided. As the joint is cut through, the bones usually fall apart spontaneously to the distance of 3 or 4 centimeters ($1\frac{1}{4}$ to $1\frac{1}{2}$ inches). The wound is protected with a fold of iodoform or of sublimate gauze during the delivery. If hemorrhage occurs, it should be controlled by packing with iodoform gauze or by hemostatic suture.

An important improvement in the technique of symphysiotomy has recently been proposed by Dr. M. L. Harris of Chicago.¹ After dividing the symphysis he detaches the subpubic ligament (which has been left uncut) and the deep perineal fascia from the pubic arch, using for the purpose a blunt-pointed bistoury under guidance of the finger and hugging the bone closely on each side. The pubes are allowed to separate gradually, and the detachment of the fascia from the bones is continued until its fibres are no longer felt to be tense. The separation of the symphysis will then have been carried as far as can be done without injury to the sacro-iliac joints.

The object of this step is at once apparent. The deep perineal fascia, by reason of its attachment to the ischio-pubic rami, is so much stretched transversely, when the joint is opened to any great extent, that in the usual method of operating it is often ruptured. This fascia is perforated by the vagina, the urethra, and the dorsal vein of the clitoris. It surrounds a part of the cor-

¹ *Am. Journal of Obstetrics*, Dec., 1894.

pora cavernosa of the clitoris, and it contains between its layers the cavernous bodies about the vagina and urethra and the plexus of veins around the vesical neck. Laceration of the fascia takes place in the direction of least resistance, which is usually through the line of perforation. The urethra and the clitoris are frequently torn. The vagina, which is always a septic tract, is sometimes invaded by the tear. The venous plexuses and the cavernous bodies involved in the injury, and in a region that is much increased in vascularity during pregnancy, are often the source of alarming hemorrhage. The bleeding, which is mainly or wholly venous, is sometimes extremely difficult to control, the veins being held open by the stretched fibres of the torn fascia, and it has even ended fatally. All these injuries, too, greatly increase the risk of sepsis. Most of the dangers and complications of symphysiotomy are prevented by preserving intact the deep perineal fascia.

While dividing the joint and separating the fascia the lateral halves of the pelvis must firmly be supported. Otherwise they may prematurely be forced apart, and the fascia be torn, should the fetal head be suddenly driven down by a violent uterine contraction. In all cases the joint is to be opened to the fullest extent permissible, in order to prevent possible rupture of the fascia from unexpected spreading of the bones during delivery.

To detach the fascia from its subpubic attachment in the manner described, the primary incision must be free, extending from a little above the symphysis nearly down to the clitoris.

Increasing experience is unfavorable to the osseous suture. Good union is obtained without it, while wiring the bones may lead to caries and persistent fistula.

After the joint has been opened the patient may be permitted to deliver herself, assisted, if necessary, by expressio fetus. As a rule, it is better to terminate the labor at once by forceps or by version. The woman is thus spared the danger of long-continued anesthesia and of prolonged exposure of the operation wound. In general, the choice between forceps and version should be decided in accordance with the commonly accepted rule of version before and forceps after engagement of the head. In breech presentation the delivery will not differ from the usual method of breech extraction.

During the delivery the lateral halves of the pelvis should be supported by an assistant to prevent too wide separation of the pubic bones, care being taken to prevent undue strain upon the anterior soft parts during the extraction of the child. Some writers have advised a perineal incision when necessary to avert laceration of the soft structures that bridge the pubic interspace. The same end would perhaps be accomplished better by the usual lateral episiotomy incisions. The placenta should be delivered before the joint is closed.

After delivery the ends of the sundered bones are brought together by pressure on the trochanters. As the lateral halves of the pelvis are approximated, the retropubic structures are pressed gently backward to prevent injury to the bladder or the urethra by pinching between the bones.

Leopold sutures the cartilages with silk; Zweifel unites the joint surfaces

by three buried sutures of catgut or of silkworm gut. Silver wire irritates, and is open to the objection that it may interfere with a subsequent operation. Most operators wholly reject the bone suture as unnecessary. Immobilization of the joint after operation, however, by means of the usual bandage is troublesome and difficult, and in certain instances persistent looseness of the symphysis has remained. The wound in the soft parts is closed with silk sutures. It is advisable to include the fibrous structures on the anterior surface of the joint in the sutures which close the wound of the soft parts.

After-treatment.—Absolute immobilization of the pelvis during convalescence is essential to immediate and firm union of the joint. Many operators have trusted to a strong muslin binder, simple or starched or painted with water-glass. A canvas belt provided with straps and buckles for tightening makes a satisfactory dressing. The broad part of an Esmarch bandage has been used. An excellent plan, which has been adopted by several American operators, consists in the use of adhesive straps of rubber plaster, supplemented with the muslin binder. Three broad strips of plaster are carried across the abdomen from one wing of the pelvis to the other above the wound. The muslin binder is pinned tightly over the plaster straps. The adhesive straps are particularly useful as a partial support to the pelvis while the muslin bandage, which frequently becomes soiled, is being changed. Garrigues suggests the use of Martin's roller-bandage of solid rubber. One operator has used a wire cuirass to keep the bones together. Gueniot proposes an apparatus which he calls an "iliac compressor," consisting of lateral plates well padded, compression being applied by means of anterior and posterior straps. Pinard and others have made use of a special bed with appliances for retention of the bones and for suspending the patient.

Vaginal and vulvar lacerations should be closed by suture. The bladder and the urethra should be examined for possible injuries. An ounce or two of boric acid and iodoform (1 : 8) may be left in the vagina to keep the discharges sweet, and a large absorbent pad may be placed over the vulva. The patient is put in bed on her back, with the knees lightly tied together and the limbs outstretched. This position best favors the coaptation of the sundered bones, and should therefore be maintained until reunion of the joint is established. For evacuation of the bowels or the bladder the patient may be lifted upon the bed-pan, the nurse seizing the hips over the trochanters. The use of the catheter is frequently necessary for the first few days, but it should be avoided if possible. The dressing of the pubic wound may remain undisturbed for a week unless it becomes soiled by the lochial discharges. A constant object of solicitude is the pelvic bandage. It should be examined several times daily, and be tightened as often as the least slackness is noted. It is exposed to soiling with urine and fecal discharges, and it is only by the utmost vigilance that proper cleanliness can be maintained. The simple muslin binder must be replaced frequently with a fresh one. While it is being changed the lateral halves of the pelvis should be supported firmly by an assistant. If a water-glass or a plaster dressing be used, the parts of the bandage liable to be

soiled may be protected by a folded towel or a napkin properly placed under the buttocks and frequently changed. The bowels should be kept open as in other cases. The pelvic bandage is to be worn from four to six weeks. The patient may usually leave her bed at the expiration of three weeks, and leave her room by the end of a month.

Cesarean section is the operation of removing the fetus from the mother by opening the abdomen and incising the uterus. Among the ancients it was done immediately after the death of the mother; but not until the fourteenth or the fifteenth century is there any record of the operation being performed upon a living mother. The maternal mortality was so great that the operation was condemned by Ambroise Paré, Mauriceau, and others, and for a long time was practically abandoned. The cause of death was usually hemorrhage or sepsis. The uterine wound was not closed, because it was thought that the alternate contractions and relaxations of the uterus would make the stitches tear out. The uterine wound was left gaping, and eventually closed by adhesive inflammation to the abdominal wall. The cicatrix which was formed varied greatly in depth and strength, was extremely liable to subsequent rupture, and occasionally permitted hernia to take place. The use of the uterine suture was advocated and practised in the beginning of the present century; nevertheless, the mortality remained high until Porro (1876) supplemented the ordinary section by amputating the uterus and including the stump in the abdominal suture. But the greatest advance was made in 1882 by Sänger of Leipsic, who proposed the complete closure of the uterine wound by multiple sutures; to him is in great measure due the credit of perfecting the modern operation. Its success is mainly attributable to three causes: (1) A strict antiseptic technique; (2) complete closure of the uterine wound by multiple sutures; and (3) the deliberate selection of the operation before the beginning of labor, and its performance before the patient's strength has been exhausted or her passages infected by repeated examinations and fruitless attempts to deliver by forceps or by version. Since the introduction of the Sänger operation craniotomy upon the living child has been wellnigh abandoned in France, and even the mutilating Porro operation has been restricted within very narrow limits.

Indications.—Cesarean section may be performed in the interest of the mother or of the child when safe delivery by version or by forceps is impossible. If the mother is moribund and the child is still alive, its life will depend upon a speedy delivery; with the mother's consent the operation may be performed to save the child. But the cases of real difficulty are those in which the delivery of a living child is impossible in any other way than by Cesarean section, yet the mother might be delivered with comparative safety by performing a craniotomy. Is it permissible to destroy the child in order to save the mother? Has she the right to refuse Cesarean section and to demand craniotomy in her own interest, or to insist upon whatever operation will give her the best chance of recovery, regardless of her child? Has the obstetrician the right to weigh one life against another, and decide to take the one by craniotomy or to jeopardize the other by Cesarean section? These are serious questions, with import-

ant moral and religious bearings, which the physician should not be called upon to decide. He should fortify himself by consulting with a *confrère*, and then, having laid the medical aspects of the case plainly before the patient and her friends, should leave the ultimate decision to them. Undoubtedly his first duty is to his patient, but he is not called upon to over-persuade her or to override her wishes. After a serious accident a surgeon may recommend the amputation of a limb as the only means of saving life, and may even feel compelled to retire from the case if his advice is not taken; but he has neither the moral nor the legal right to amputate the limb against the will of his patient. The indications for Cesarean section are generally classed as *absolute* and *relative*.

Absolute Indications.—The indication is absolute when it is impossible to extract the fetus, either living, dead, or mutilated, through the natural passage. This may be the case in extreme pelvic contraction from arrested development, rickets, or osteomalacia, or where the passage is blocked by tumors of the pelvis (osseous) or of the uterus and the soft parts (carcinoma, fibroma, etc.). The modern symphysiotomy has narrowed the limits of Cesarean section somewhat, so that the indication is not now considered absolute unless the conjugate is 6 centimeters ($2\frac{1}{2}$ inches) or under, the child being well-developed and at full time. Some authorities do not consider even 6 centimeters ($2\frac{1}{2}$ inches) as an absolute indication if the child is small and the head is mouldable.

After it has been decided to deliver through an abdominal incision, it must still be determined whether it is better to remove the uterus by the Porro operation, or, by performing the Säger operation, to subject the patient to the risk of a possible subsequent pregnancy. In some cases the difficulty may be overcome by ligaturing the Fallopian tubes or removing the appendages before closing the abdominal wound. In doubtful or debatable cases individual circumstances must decide, but, in general, it may be said that the Porro operation is clearly indicated in preference to the Säger—(1) if the uterus is infected, the chances of the mother's recovery being much increased by removal of the infected organ; (2) if there is partial or total obstruction of the parturient canal by tumors; (3) if there is carcinoma of the uterus, especially of the cervix; (4) in osteomalacia; (5) if complete inertia of the uterus occurs during the course of the operation.

Relative Indications.—The relative indications are difficult to formulate, and must generally be determined by the individual peculiarities of the case. A degree of pelvic contraction or obstruction less than is requisite to constitute an absolute indication, but yet sufficient to make the safe delivery of a living and viable child by the natural passages doubtful, may be considered a relative indication. A conjugate of 6 to 8 centimeters (from $2\frac{1}{2}$ to $3\frac{1}{2}$ inches) and tumors of the pelvis or of the soft parts causing moderate obstruction are the commonest relative indications. The alternative operations are symphysiotomy, forceps, version, and craniotomy (see p. 543).

Time to Operate.—There is still a difference of opinion as to the best time to operate. Some operators wait until labor has fairly begun, in order to secure

free drainage through the dilated cervix and to diminish the risks of hemorrhage; others operate four or five days before the expected date of labor. The latter method is preferable, because the patient can be prepared as carefully as for any other celiotomy, and the operation can be done deliberately, with all the advantages of a good light, trained assistants, etc. Those who wait for the onset of labor may have to operate hurriedly or at night, without proper preparation or skilled assistance; moreover, the membranes may rupture before the operation, which is always a disadvantage. Cesarean section is an elective operation whose success depends in great measure upon its being performed under the conditions most favorable to recovery; it seems, therefore, more prudent for the operator to determine for himself the time, place, and conditions of the operation than to trust to the uncertainties of accident or of chance.

The objections commonly urged against operating before labor are (1) that hemorrhage may take place on account of imperfect uterine contraction, and (2) that sepsis may occur from retention of the lochia, the undilated cervical canal not permitting free drainage. Experience shows that the first objection is unfounded, because the uterus does contract promptly and well after being incised and emptied. The second objection can easily be overcome by dilating the cervix from above and passing a drainage-tube or a strip of gauze into the vagina. That these objections are theoretical rather than practical seems to be proved by the results of the early operation in the United States, where in sixteen operations fourteen mothers and all the children were saved.

General Preparation.—If possible, the patient should be prepared as carefully as for any other celiotomy, special attention being paid to the state of the bladder and the bowels, disinfection of the vagina, and scrubbing and cleansing of the abdomen. The operation should be performed under an anesthetic. Some operators prefer chloroform to ether, as anesthesia is more rapidly produced and the child is less likely to be asphyxiated. The instruments required are scalpels, strong scissors, hemostatic forceps, needles and a needle-holder, sutures, a hypodermatic syringe with a supply of ergotin and ether, an irrigator, a piece of elastic cord or tubing, and occasionally a sharp curette and a thermo-cautery. There should be provided also a plentiful supply of aseptic towels, sponges, gauze, and boiled water both hot and cold. The best needle for the uterine suture is half-curved, round-bodied, and without a cutting edge. Three assistants are required—one to give the anesthetic, another to take charge of the fundus and the uterine incision, and a third to tighten the rubber band around the lower uterine segment.

The Abdominal Incision.—Operators differ as to the best method of delivering the child. Some make a long abdominal incision and turn out the uterus before they open it and extract the child. Others make a much shorter incision, open the uterus, and extract the child before they turn the uterus out of the abdominal cavity. In the first method time is saved and fluids are easily prevented from entering the abdomen, but the disadvantages are serious. A very long incision is required—usually from a point 4 centimeters ($1\frac{1}{2}$ inches)

above the symphysis pubis to one about 6 centimeters ($2\frac{3}{4}$ inches) above the umbilicus; an enormous cicatrix remains, which weakens the linea alba and leads sometimes to hernia, necessitating subsequent operation. In the second method the incision need seldom be more than 15 centimeters (6 inches) in length, extending from a point 4 centimeters ($1\frac{1}{2}$ inches) above the symphysis to a point 4 centimeters ($1\frac{1}{2}$ inches) below the umbilicus. This incision is usually sufficient for the introduction of the hand and the extraction of the child. Greater care is needed to keep fluids out of the abdomen, but the final results are better and the abdominal walls are less liable to be weakened. Whichever method is selected, a small incision should be made in the linea alba, and when the peritoneal cavity has been opened a finger is introduced as a guide and the incision is enlarged upward and downward by means of a strong pair of scissors. There will be less bleeding than if the whole incision is made with a knife.

When the long incision is employed, half a dozen long wire sutures are passed through the upper portion of the wound and left to be tightened afterward. The uterus is then pushed up into the incision and the abdominal walls are pressed back over it. As it emerges, the first assistant covers it with towels wrung out of hot water and supports it until a large flat sponge or a gauze pad, also wrung out of hot water, has been adjusted behind it, and the wire sutures are tightened. The rubber band is then passed around the lower uterine segment below the presenting part, and the ends are given to the second assistant. The anterior surface of the uterus is then incised in the middle line without reference to the situation of the placenta. It is unnecessary to spend time detaching the placenta and pushing it to one side when it is in the way, as recommended by some operators.

The uterine incision should be about 10 to $12\frac{1}{2}$ centimeters (4 to 5 inches) in length. An opening is made, just above the lower uterine segment, large enough to admit one finger, and the incision is enlarged upward by means of a pair of scissors. The child is then seized by the extremity lying nearest the incision, whether it be the head, the breech, or the foot, and is extracted as quickly as possible. The cord is quickly tied and cut, the elastic ligature is tightened, the placenta and the membranes are carefully peeled off and removed, and the uterine cavity is thoroughly irrigated with hot water or a hot antiseptic solution, such as corrosive sublimate (1 : 5000). Some operators dry the uterine cavity and dust it freely with iodoform just before closing the uterine wound; others continue irrigation with hot water while the sutures are being introduced and tied. After the uterine wound has been closed the elastic cord is relaxed and any oozing is checked with a hot sponge. The uterus, which has been kept well compressed by the first assistant, is cleansed and returned into the abdomen. The pelvic cavity is irrigated and sponged dry, the toilet of the peritoneum is made, and the abdominal wound is sutured as in an ordinary celiotomy. The usual antiseptic dressings are applied, and a hypodermatic injection of ergotin is given to prevent hemorrhage. The patient is put to bed, hot-water bottles are applied to the limbs, no food is given for twelve hours, and

the bowels are moved within the first twenty-four hours. During the first week the nourishment should be liquid exclusively. The abdominal sutures can generally be removed from the tenth to the fourteenth day, and in favorable cases the patient may be able to sit up by the middle of the third week.

If the uterus is incised before being turned out, the technique is somewhat different. The abdominal incision is only about 15 centimeters (6 inches) long; the hand is passed into the abdominal cavity and swept around to ascertain the presence and situation of any adhesions. The elastic loop, held between the fore and middle fingers, is passed over the fundus and adjusted about the lower uterine segment; the ends are then given to the second assistant, who makes upward traction on them, thereby preventing hemorrhage and holding the uterus steadily against the pubes. While the uterine incision is being made the first assistant keeps the uterus firmly against the abdominal incision, and while the child is being extracted he promotes uterine contraction, makes steady pressure on the abdominal walls from above downward and forward, and gradually presses the uterus out through the abdominal incision. Wire sutures are not required in the upper part of the wound to keep the intestines from protruding. The subsequent steps of the operation are the same as in the method previously described.

Some operators make the operation comparatively bloodless by tightening the elastic ligature before the uterus is incised, and not relaxing it until the uterine wound is closed; others do not tighten it until after the delivery of the child. If the ligature is drawn too tight or is kept applied too long, there is danger of paralyzing the uterine muscle and producing subsequent inertia and hemorrhage. To overcome this difficulty Singer proposes the use of an antiseptic towel folded to form a band. Other operators use no band at all, but direct the second assistant to grasp the lower uterine segment before the uterus is incised, and to compress it firmly with his hands until the child has been delivered and the wound has been sutured. Hemorrhage into the abdominal cavity sometimes occurs subsequently from uterine inertia or faulty suturing. If slight, it may be checked by an ice-bag over the uterus and a hypodermic injection of ergotin; if abundant, the abdomen must be reopened, the clots turned out, and the bleeding point secured. Before the uterine wound is finally closed some operators dilate the cervix from above and pack a strip of iodoform gauze 7.5 centimeters (3 inches) wide and 91.5 centimeters (3 feet) long into the uterine cavity, passing the end through the cervix into the vagina, to provide free drainage and to guard against intra-uterine hemorrhage by stimulating contraction. This practice is unnecessary in most cases unless the uterine muscle is flabby and weak and does not contract well.

The Uterine Suture.—Silver wire, silk, and catgut sutures are employed, but, on the whole, silk or well-prepared catgut seems to be preferable. Most operators use two sets of interrupted sutures—a deep layer to approximate the divided muscular coats, and a superficial layer to close the peritoneum. The deep sutures of No. 2 silk pass from 3 to 6 millimeters ($\frac{1}{8}$ to $\frac{1}{4}$ inch) from the border of the incision diagonally down through the muscular tissue to, but do

not include, the decidual lining (Figs. 509, 510). They are about $\frac{1}{2}$ inch apart, and are eight to twelve in number, according to the length of the wound. As soon as they are all introduced the uterine cavity is irrigated with a hot sub-

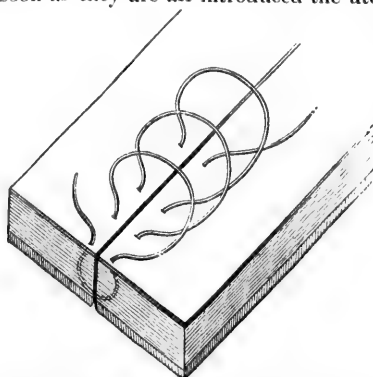


FIG. 509.—The deep suture placed as a running stitch; it includes peritoneal and muscular coats, but not decidual lining (modified from Grandin).

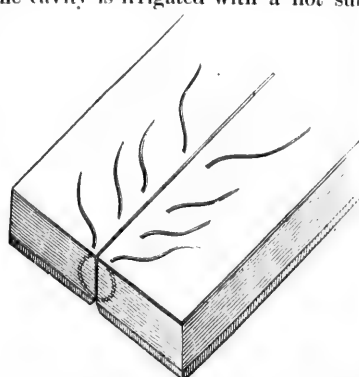


FIG. 510.—The running stitches of the deep suture cut to form interrupted sutures (modified from Grandin).

limite solution, the sutures are tied securely, and the ends are cut short. The superficial sutures of catgut or of No. 4 silk are then put in to bring the peritoneal borders into close apposition (Figs. 511, 512). The Lembert suture is generally employed for this purpose, though it is claimed that equally good results may be obtained by simply approximating the cut edges. One superficial suture is introduced over each deep one, and another midway between,

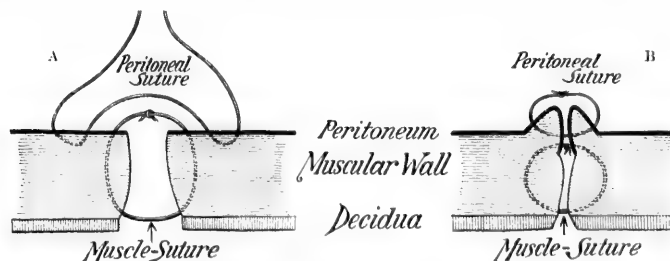


FIG. 511.—Diagrams of the peritoneal and muscle-sutures: A, before they are drawn tight and tied (modified from Fritsch); B, the two stitches after tying. The muscle-suture is buried and the upper suture folds the peritoneum together.

making the number of superficial sutures double that of the deep ones. When they are all tied the knots of the deep sutures are completely buried and the opposing surfaces of peritoneum are in close apposition (Fig. 511, B). The action and relations of these two layers of sutures are shown in Figure 511.

Dudley¹ of New York recently adopted a continuous catgut suture of three layers, which he claims to be superior to the ordinary interrupted silk suture in two layers. The first row, which begins at the inner edge of the upper angle of the wound, includes the decidua and the inner muscular coats. It is

¹ *American Journal of Obstetrics*, Jan., 1895, p. 16.

continued to the lower angle of the wound, and when tightened closes off the uterine cavity. Without cutting or tying the catgut, the second row is carried back to the upper angle, including the rest of the muscular tissue and sinuses, care being taken to pass the needle through the cut ends of any sinuses visible. When this row is tightened about three-fourths of the depth of the uterine tissues has been closely approximated. Without cutting or tying the catgut, the third row, by an over-and-over stitch, completely buries the two lower layers and brings the peritoneal surfaces together; the catgut is finally tied at the lower angle of the incision. The advantages claimed for this method are—(1) that it brings the whole depth of the uterine wound into closer apposition, shortens the wound considerably, and prevents the danger of leakage between the sutures and the formation of blood-clots between the wound-edges; (2) that the suture is completely buried from beginning to end except where it catches the peritoneum; (3) that there is no rolling in of the cut surfaces and no eversion of the lips of the wound, and catgut is not more liable to be septic or to become septic than silk. It is urged against catgut that it is liable to stretch and to permit gaping of the wound, and that the knots are apt to untie; this may occur in the case of interrupted, but not with continuous, sutures; moreover, the abdominal surface of the uterine wound is covered with lymph in a few hours, and the peritoneal cavity is safe so far as the wound is concerned. In eight or nine days the catgut is absorbed and the wound is perfectly united; but when silk is used the suture becomes encysted, and some time elapses before it can be disintegrated and removed. Dudley claims that with his method there is less liability of adhesion taking place between the uterus and the abdominal walls, and there is no danger of cutting down upon an encysted suture in a subsequent operation. He performs the whole operation, from the first incision in the abdominal wall to its final closure, under constant irrigation with hot water or with hot sublimate solution.

Cesarean Section immediately after the Death of the Mother or when She is Moribund.—When the mother's life is extinct there is no special technique, as the main point is to extract the fetus as quickly as possible. The operation is most likely to succeed if death has been sudden; if it has been slow or gradual, the child is usually asphyxiated beyond hope of restoration before the mother's life is extinct. If she is living, but *in extremis*, the operation must be done deliberately and with due regard to her safety, for one cannot be certain that she must inevitably succumb.

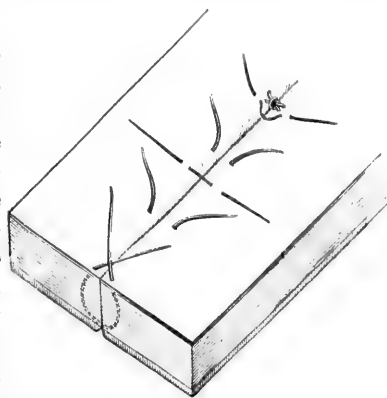


FIG. 512.—Two peritoneal sutures are here shown, one lying level, and the other as it is in process of tying; beneath the latter suture is seen the knot of the tied muscle-suture (Grandin).

Porro Operation.—The procedure in this is precisely the same as in the Sänger operation until the uterus has been turned out of the abdominal cavity. The elastic ligature is then passed around the lower uterine segment and is tied loosely, and a large piece of thin rubber sheeting, a thermo-cautery, and a Koeberlé éraseur are prepared for use. A small opening is made in the rubber sheet, to permit it to be passed over the fundus and carried down to the elastic band. It serves to prevent fluids from the uterus entering the abdominal cavity. The elastic ligature is then tightened, the uterus is incised, the child is delivered, the placenta is detached and removed, and the uterus and appendages are cut away just above the rubber sheeting. If the child has been extracted before the uterus is turned out of the abdomen, the ligature will have already been tightened, so that it remains only to slip the rubber sheet over the uterus as soon as it emerges through the abdominal incision, and amputate without delay. Many operators adopt Müller's method of applying the elastic ligature before incising the uterus. Fehling passes an additional ligature beneath the first as a precautionary measure. After the uterus is removed the stump is carefully disinfected and cauterized; it is then treated extraperitoneally, or the entire stump and cervix are removed and the abdominal wound is closed. The extraperitoneal method is more rapid, and is generally preferred if the patient is very weak or is suffering from shock. The loop of the éraseur is made to encircle the stump just beneath the rubber ligature, and is tightened until the tissues are blanched. Care must be taken not to enclose the bladder-wall in the loop of the éraseur. The rubber band is then removed, the stump is trimmed and cauterized, and is transfixed above the wire loop with two strong steel pins passed transversely across the abdominal wound. The peritoneum is stitched around the stump with a continuous catgut suture, the abdominal cavity is cleansed and dried, and the abdominal incision is sutured. An iodoform dressing is applied, and left undisturbed for several days unless hemorrhage occurs or the temperature begins to rise. If the stump is moist, the dressings will soon become soaked with discharges; they must be removed and the stump thoroughly disinfected, any sloughy pieces being clipped off with scissors, and fresh dressings applied. If there is any bleeding from the stump during the first three or four days, the bleeding point should be found and ligatured. The stump sloughs away in from ten to fifteen days, leaving a large granulating surface which is sometimes slow to heal. To hasten this process various expedients are employed. Sutugin scrapes and pares the surface of the stump to produce a raw surface, and closes the borders with ligatures, introducing a small tent of iodoform gauze into the lower angle of the wound for drainage. Others dilate the cervix and pass a strip of gauze from above through the cervix into the vagina. The intraperitoneal method is theoretically preferable, but so far its results are not ideal. The technique varies according to the circumstances of the case, but the main line of procedure is to free the bladder from its attachments to the lower uterine segment after the uterus has been removed and the stump has been disinfected, secure the broad ligament on each side with strong silk ligatures, tie the uterine arteries, divide the vaginal attach-

ments of the cervix, and remove the stump. Any bleeding points are then tied, the ends of the ligatures being left long, so that they may be passed down through the vaginal opening. Strips of iodoform gauze are firmly packed in the upper part of the vagina, and the peritoneal cavity is closed off by stitching the peritoneal covering of the bladder to the peritoneal layer of the cul-de-sac with a continuous catgut suture. The abdominal cavity is then carefully cleansed and dried and the abdominal wound is sutured. The object of this method is to close the peritoneal cavity completely, turn the raw surface downward toward the vagina, and obviate the necessity of draining from above. Unless the operator is expert in abdominal work, it will be safer and easier for him to choose the extraperitoneal method. If the uterus has been infected, it is well to close the abdominal wound as much as possible before beginning to work with the pedicle, in order to avoid infecting the peritoneal cavity.

Laparo-elytrotomy.—This operation was devised by Thomas to avoid the risks of opening the abdomen and wounding the uterus; but since the perfecting of the Säger and Porro operations has reduced these dangers to a minimum the necessity for laparo-elytrotomy can scarcely be said to exist. The method of procedure is to incise the abdominal walls in the line of Poupart's ligament, lift the peritoneum, dissect down to the vagina, and tear it through transversely, so that the cervix may be reached and the child be delivered through the passage thus made. This operation has been done thirteen times, seven of the mothers being saved.

Prognosis of Cesarean Section.—The mortality in pre-antiseptic days ranged from 30 to 50 per cent. It has been reduced to about 10 per cent. by doing the operation early, and not as a *dernier ressort*, and by practising a scrupulously aseptic technique. In private practice the prognosis for the mother depends very much upon the urgency of the case and the possibility of securing favorable conditions for the operation. It is far more difficult to carry out a proper technique in private than in hospital practice. The prognosis for the child is good; from 90 to 95 per cent. of the children have been saved. Since the mother should not run much more risk from Cesarean section than from craniotomy, while the child is almost certainly saved in the one case and deliberately destroyed in the other, there can be very little question at the present day as to the choice of operation. In fact, craniotomy upon the living child is justifiable only under exceptional circumstances. It must be admitted, however, that the results of the Cesarean section in America have so far been disappointing, the mortality from the operation being much higher than in Europe. It should not be so, and we cannot expect that Cesarean section will replace craniotomy until our results have been considerably improved.

In the Porro operation the maternal mortality ranges higher, owing to the more serious condition of the mother before operation. Notwithstanding the unfavorable circumstances usually present, the mortality has been reduced to about 25 per cent. In Italy the mortality is about 16 per cent., as the Porro operation is performed in cases where the Säger operation would be preferred elsewhere. Breisky performed 11 operations, and Leopold 7, without a death.

Craniotomy and Embryotomy.—These are the terms applied to all destructive operations by which the volume of the fetus is reduced in order to permit delivery *per vias naturales*. Although in a literal sense all such operations might be included under Embryotomy, yet general usage has sanctioned a more restricted application of the term. *Craniotomy* is used to denote mutilation of the fetal head; *embryotomy*, mutilation of the fetal trunk. When a destructive operation has to be performed, the choice of method is determined by the nature of the presentation. Since the head presents in the great majority of cases, craniotomy is most frequently done, while embryotomy is comparatively rare. Whatever may be the circumstances of the case, that operation should be chosen which is likely to expose the mother to the least risk.

The operative procedures included under the general terms craniotomy and embryotomy may conveniently be classified as follows:

1. Upon the head:
 - (a) Perforation;
 - (b) Cranioclasia;
 - (c) Cephalotripsy;
 - (d) Basiotripsy.
2. Upon the neck: Decapitation.
3. Upon the trunk: Evisceration or eventration.

Indications.—It is of primary importance to determine whether the fetus is living or dead. If dead, its bulk should be reduced whenever there is sufficient disproportion to make delivery difficult or dangerous. It is far better to mutilate a dead fetus in order that the mother may be delivered easily and safely than to subject her to the risks of a tedious and difficult forceps operation. Esthetic considerations and regard for appearances should not be allowed to weigh against the mother's safety. But when the child is alive the question becomes entirely different. Undoubtedly, in recent years symphysiotomy, Cesarean section, and the induction of premature labor have greatly narrowed the field of the destructive operations, but are we quite prepared to admit that craniotomy upon the living child is never justifiable? Pinard and his followers boldly take this ground, so do a few operators who have had exceptionally good results from Cesarean section; but most obstetricians feel that the results of the conservative operations do not yet warrant such a sweeping assertion. Until it has been established that the maternal mortality after the conservative operations is not greater than that after embryotomy, it would be rash to say that mutilation of the living child is never justifiable. In the minor forms of dystocia the choice of operation will probably lie between craniotomy and symphysiotomy or the induction of premature labor; in the major forms, between craniotomy and Cesarean section. The maternal mortality after basiotripsy in the Paris hospitals is practically *nil* when done in selected cases and under favorable circumstances. Leopold and others have had almost as good results from Cesarean section under similar conditions. But in private practice, when the skill and experience of the operator are not usually so great, when there is lack of skilled assistance and the surroundings are unfavorable, the results

after either operation will be less favorable. When Cesarean section is performed as an elective operation, the mortality should not be greater than 10 per cent.; but when done as a *dernier ressort*, after ineffectual attempts to deliver by forceps or by version, the risk to the mother becomes very great indeed. Craniotomy in suitable cases, done deliberately and without force, should be little more dangerous than a forceps operation, but when done after repeated forcible attempts to deliver with forceps, especially if the disproportion between the fetus and the maternal passages is great, it becomes one of the gravest and most difficult obstetrical operations. Embryotomy on the living child involves such serious responsibility that it would rarely be chosen as an elective operation. Practically, therefore, elective embryotomy is seldom pitted against elective Cesarean section. When the operation is one of election, Cesarean section is generally the choice; when it is a *dernier ressort*, embryotomy is usually safer for the mother. The whole question turns upon an early and exact diagnosis. If the patient has been examined carefully before the onset of labor to determine approximately the relative size of the fetus and the maternal passages, there should be very little difficulty in deciding upon the best course to pursue. But if labor has been allowed to drag along, and the disproportion has been diagnosed only after repeated failures to deliver by forceps or by version, the case assumes a different aspect, and the chances of safe delivery by any means are impaired. Such cases emphasize the necessity of making a careful examination of the pelvis in all pregnant women whose appearance or history suggests the possibility of deformity or disproportion. There is really no good reason why an amount of disproportion calling for Cesarean section or embryotomy should not be made out long before the onset of labor. But very often the physician does not see his patient until labor is well advanced, and then the case may call for prompt action, even though the surroundings are unfavorable and skilled assistance cannot be procured. Under such circumstances, if the disproportion is slight or moderate, a craniotomy could probably be done with far less risk to the mother than a symphysiotomy or a Cesarean section; but if the disproportion is extreme, craniotomy becomes a very difficult and dangerous operation, and Cesarean section will give the mother a better chance even if the operator is inexperienced. It is evident, therefore, that no positive rules can be laid down, for, even in the mother's interest, sometimes one operation may be preferable and sometimes another. At all events, it is premature as yet to say that mutilation of the living child is never justifiable. Under any circumstances the physician should not assume the full responsibility in such cases, but should leave the ultimate decision to the patient and her friends, after having laid the facts fairly before them.

The ordinary indications for embryotomy may be grouped as follows:

- (1) Deformity of the pelvis, where forceps or version is either impossible or is dangerous for the mother.
- (2) Disproportion between the parturient canal and the fetus that cannot safely be overcome by a conservative operation.
- (3) Tumors—uterine, ovarian, malignant, or osseous.



FIG. 513.—Perforator of Smellie.



FIG. 514.—Perforator of Simpson.



FIG. 515.—Perforator of Naegle.



FIG. 516.—Perforator of Pinard.



FIG. 517.—Perforator of Barnes

FIG. 518.—Trephine of Braun
(straight and curved)

FIG. 519.—Craniotomy forceps of Meigs.

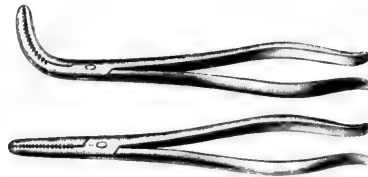


FIG. 520.—Cranioclast of Barnes.



FIG. 521.—Cranioclast of Simpson.



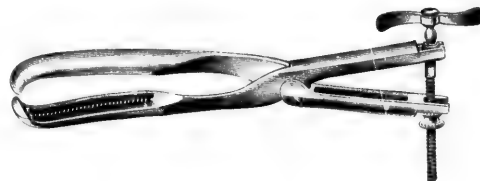
FIG. 522.—Cephalotribe of Braun.



FIG. 523.—Cephalotribe of Lusk.



FIG. 524.—Cephalotribe of Hicks.



(4) Monstrosities, such as hydrocephalus.

(5) Impaction of the presenting part, as in locked twins or in some face presentations, especially if there are swelling and inflammation of the vagina or of the cervix resulting from long impaction.

(6) Eclampsia and other causes which demand immediate delivery, if it cannot safely be accomplished in any other way. If the liquor amnii has long been drained away, the uterus sometimes becomes tetanically contracted about the fetus, and rupture is imminent; in such cases forceps, version, and Cesarean section are dangerous, and embryotomy affords the best chance for the mother. The child will probably have perished long before the question of embryotomy comes up for consideration.

Instruments.—Space does not permit a description of the numerous ingenious instruments which have been devised for the mutilation and extraction of the fetus. As the prime object of these operations is to reduce the bulk of the fetus, the first step is generally to perforate the presenting part and evacuate its contents, and then to apply a powerful instrument to compress it, so that it may safely be extracted through the narrowed passages. When the fetus cannot be so compressed, its bulk must be reduced by breaking it up and removing it piece by piece. Perforation is done by means of a perforator; compression is made by a cephalotribe, a cranioclast, or a basiotribe; comminution of the vault of the skull by a pair of small craniotomy forceps; decapitation by a blunt hook or an embryotome. So far as possible, embryotomy instruments should be made of metal and be so constructed that they can easily be rendered aseptic.

Perforators.—Three types of perforators are in use—the scissors, the trephine, and the heavy, spear-shaped perforator of the basiotribe. The scissors perforator may be straight or curved on the flat; on the whole, the straight form is the safer and answers the purpose very well. The original model of Smellie (Fig. 513) is still in use, but Simpson's (Fig. 514), Barnes's (Fig. 517), or Pinard's modification (Fig. 516) is preferable. Oldham's and Naegele's (Fig. 515) are more powerful instruments, but have no special advantages. The Germans prefer the trephine, claiming that the brain-substance can more easily be broken up, the skull being perforated through a bone, and not through a suture or a fontanelle. The models most commonly used are Braun's (Fig. 518) and Martin's, either straight or curved. They are harder to manipulate, and an assistant is required. The spear-shaped perforator of the basiotribe is not withdrawn like the other perforators, but is pushed through the brain-substance and imbedded in the base of the skull to steady the head while crushing is being done.

The cranioclast is a powerful prehensile craniotomy forceps, one blade of which is passed into the cranial cavity through the opening made by the perforator, while the other grasps the head outside. When the blades are forcibly pressed together by means of a strong compressing screw at the end of the handle, a firm grip of the head is obtained, and extraction is easy unless the passages are very small. The small blade which is passed into the skull is solid and is grooved on its convex surface, with the tenon of the lock on the

handle; the larger blade, which grasps the outside, is fenestrated and is grooved on its inner concave aspect. A moderate pelvic curve is generally given to the instrument to facilitate introduction and extraction. The favorite models are those of Barnes, Simpson, and Braun (Figs. 520, 521). The cranioclast is essentially a tractor, and is sufficient in most cases of craniotomy, unless it is found necessary to crush the base of the skull. The advantages claimed for it are—(1) that it is not apt to tear away when scalp and bone are seized together; (2) that it seldom slips when once a firm hold is obtained; (3) that the head can be seized in any diameter without fear of slipping; and (4) that when the parietal bones have been removed the base of the skull can be so seized as to bring it through a pelvis with a conjugate of only $4\frac{1}{2}$ centimeters ($1\frac{3}{4}$ inches) and a transverse of $7\frac{1}{2}$ centimeters (3 inches) (Barnes).

Cephalotribe.—This instrument was invented by Baudelocque to supersede the perforator. It is essentially a powerful compressing forceps (Figs. 522–524), made to crush the head before extracting it. The blades are applied outside the head, like those of the ordinary forceps; the instrument therefore differs essentially from the cranioclast, which has one blade inside and the other outside the skull, and is not essentially a crusher, but is simply an extractor. The cephalotribe is more bulky, takes up more room in the pelvis, does not

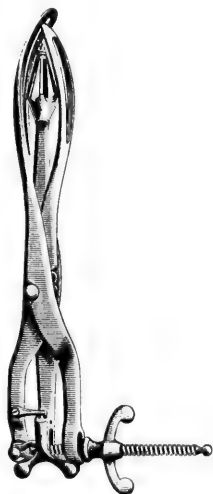


FIG. 525.—Tarnier's basiotribe.

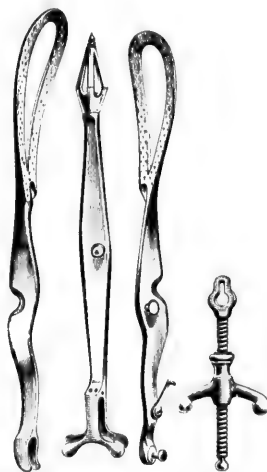


FIG. 526.—Tarnier's basiotribe (separate parts).

grasp the head so securely, and is more liable to slip than the cranioclast. The cephalotribe is therefore less useful in ordinary cases, and is nowadays very little used. The Hicks model (Fig. 524) is preferred in England, while Lusk's instrument (Fig. 523) is the favorite in America.

Basiotribe.—Tarnier's basiotribe is the most perfect instrument for craniotomy yet invented, being at once a perforator, a cranioclast, and a cephalo-

tribe, and is capable of being used in pelves measuring no more than from 4 to 6 centimeters ($1\frac{1}{2}$ to $2\frac{3}{4}$ inches) in the conjugate diameter. The cranioclast seizes well, but crushes poorly; the cephalotribe crushes well, but seizes poorly; the basiotribe combines the good points of both, for it both seizes and crushes well. The basiotribe is composed of a perforator, two blades of unequal length, and a powerful compressing screw (Fig. 525). The central piece, or perforator, consists of a straight bar of metal, terminating at one end in a fenestrated, spear-pointed tip, and at the other end in a small cross-bar, through which the compression-screw works (Fig. 526). About halfway down the handle is a tenon upon which the shorter blade articulates. The shorter blade



FIG. 527.—Tarnier's basiotribe in action; the perforator being in place, as is also the first blade.



FIG. 528.—The first blade of the basiotribe has crushed the occiput, and the second blade is applied.



FIG. 529.—The second blade of the basiotribe has crushed the sinciput.

carries a tenon upon which the longer blade articulates, and a small hook to fasten it to the perforator after the first crushing has been done. At the end of the handle is a pivot to which the compressing screw is attached. The longer blade, about 42.5 centimeters (17 inches) in length, articulates with the shorter blade, and has a groove at the end of the handle to receive the compressing screw. When closed the instrument measures from side to side 4 centimeters ($1\frac{1}{2}$ inches), from before backward $4\frac{1}{2}$ centimeters ($1\frac{3}{4}$ inches), and weighs a little less than 1000 grams ($2\frac{1}{2}$ pounds). Bar and Tarnier have recently modified the original instrument so that it can more easily be used in face presentations. The blades of this modified instrument are made a little longer and of equal length, and are so arranged that either the right or the left blade can be introduced at will after the perforator.

Hook and Crotchet.—This instrument consists of a slightly curved metal bar terminating at one end in a blunt hook and at the other end in a sharp crotchet-tip (Fig. 530). The hook is used to pull down the neck; the crotchet is sometimes caught into the orbit or the foramen magnum, after perforation, and employed as an extractor, or it may be used to break up the brain after perforation. The blunt hook may occasionally be serviceable in extracting the after-coming head following perforation. It is passed through the opening made by the perforator, and is hooked over the base of the skull. Sometimes it may be employed with advantage in the delivery of the trunk in difficult cases, if hooked under the posterior shoulder. The hook and crotchet is less used than formerly, but is nevertheless very helpful if better instruments are not at hand. It should be handled with care, for it is very apt to slip and injure the maternal soft parts.



FIG. 530.—Hook and crotchet.

Small Craniotomy-forceps.—It becomes necessary sometimes to break down the cranial vault after perforation and to remove the bones piecemeal. For this purpose a modified bone-forceps is used. The best model is Taylor's modification of Meigs's instrument (Fig. 519).

Decapitating Hook.—In neglected transverse presentations decapitation is sometimes the readiest and safest means of effecting delivery. Braun's hook is extensively used for this purpose in Germany. This instrument consists of a steel rod fitted with a strong handle at one end and a short hook tipped with



FIG. 531.—Braun's hook.



FIG. 532.—Detail of hooks, old and improved forms.

a rounded button at the other. The hook forms an acute angle with the shaft of the instrument, the distance between the button and shaft being 2 centimeters ($\frac{3}{4}$ inch, Fig. 532). Zweifel of Leipsic recently modified this instrument, as shown in Figure 531.

Embryotomes.—Several ingenious but complicated instruments have been invented for use in desperate cases. They are expensive, easily get out of order, are seldom available when wanted, are difficult to apply, and are apt to injure the maternal soft parts. However useful they may sometimes prove in large hospitals, they are practically out of the reach of general practitioners. The best is Tarnier's embryotome, which combines the blunt hook with a cutting instrument so guarded that nothing but the part grasped by the hook can be cut when the knife-blade is released from the guard.

Operation.—In no other obstetric operation is strict attention to antisepsis more important than in craniotomy, since the maternal soft parts are so liable to be wounded by the instruments or by spicules of bone from the mutilated head, and most of the subsequent ill effects are directly traceable to septic infection.

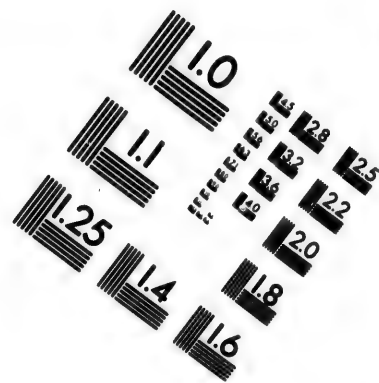
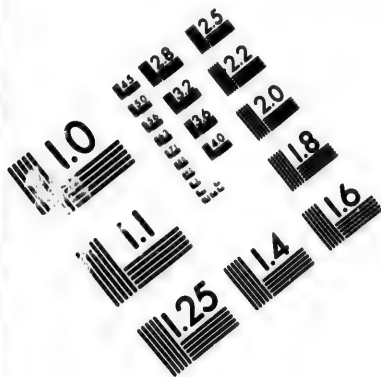
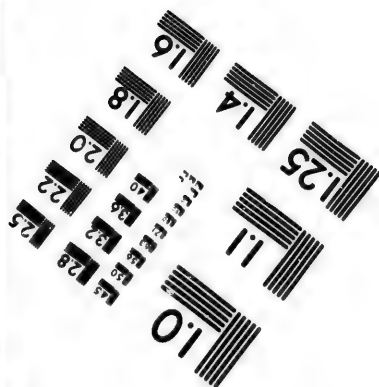
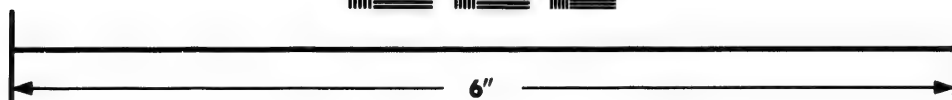
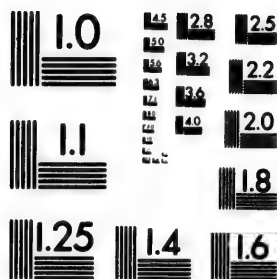


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Craniotomy of the Presenting Head.—After the bladder has been emptied and the vulva and vagina disinfected, the patient should be placed on a table in the dorsal position as for the forceps operation, an anesthetic administered, and the head steadied in the pelvis by pressure from above. Full dilatation of the cervix is advisable, but is not essential. Two fingers of the left hand are passed up through the cervix to the presenting part, and held firmly against it as a guide. Throughout the operation these fingers should guide the instruments and guard the maternal soft parts from injury. The perforator, held in the right hand, is passed along the guide-fingers to a suture or a fontanelle if possible. The point should be kept at right angles to the presenting part, to prevent slipping, and the part selected for perforation should be nearer the symphysis than the promontory (Fig. 533). Then, with steady pressure or a careful



FIG. 533.—Perforation of the head begun: the right hand is grasping the handles of the instrument. The tips should not be separated until after they have entered the fontanelle.

boring movement, the point is made to enter the cranial cavity, and the perforator is pushed home as far as the shoulder-guard will permit. The opening is enlarged by compressing the handles so as to separate the blades. The instrument is then closed and withdrawn slightly to permit its being introduced again at right angles to the first incision. The blades are again separated, then finally closed and withdrawn. By this means a crucial incision is made, through which a metal nozzle or crotchet can be introduced to break up the brain-substance. The remaining steps of the operation will be more cleanly if a syringe is attached to the nozzle and the broken-down brain-matter is washed out with sterilized water. When the fetal skull is completely emptied of brain-matter, it can more easily be compressed and extracted than if it is only slightly or partially emptied. If a suture or a fontanelle cannot easily be reached, a good perforator with a sharp point can readily be pushed through the substance of any cranial bone. In face presentations the perforator should be passed through the orbit or one of the frontal bones if possible, or, failing in that, through the roof of the mouth, behind the nasal fossæ. When the bony landmarks are

unrecognizable, perforation may be made wherever most convenient, but should then be carried very deep.

Craniotomy of the After-coming Head.—This is always a difficult operation, since the trunk interferes with the necessary manipulations. Moreover, the trephine can rarely be used, the scissors perforator is apt to slip, the thin cranial vault is out of reach, and only the thicker, denser portions of the skull are accessible. It is usually recommended to perforate through a lateral fontanelle or at the articulation of the occiput and atlas. The body of the fetus may require to be drawn upward or downward, to the right or to the left, to bring the desired point within reach of the guide-fingers. Practically, the operator must generally be content to perforate at any point behind the ear that he can reach, without troubling to find a fontanelle or a suture. If the occiput is behind the pubes, the operator passes three or four fingers under the symphysis to the occipito-atlantal articulation, while assistants steady the head in the pelvis and draw the body downward and backward. The perforator, guarded by the fingers, is inserted between the occiput and the atlas, and a crucial incision is made. After the brain-substance has been broken up and washed away the head can usually be delivered without difficulty; occasionally, however, the cranioclast is required. When perforation of the occiput under the symphysis is difficult or dangerous, the body may be drawn upward and the perforator introduced through the mouth or the orbit. If the occiput is posterior, the body is raised until the perforator can be pushed into the occiput posteriorly. If the head lies transversely in the pelvis and cannot be rotated into the antero-posterior diameter, the body may be drawn upward or downward and the side of the head be perforated near the ear. Strassmann of Berlin recently proposed perforating between the chin and the neck (Fig. 534),



FIG. 534.—Craniotomy on the after-coming head: one method of perforating.

passing the instrument through the base of the tongue until its point is felt by the fingers in the mouth, then pushing it through the posterior nares into the foramen magnum, when the blades are separated and the base is broken up.

A nozzle is passed through the opening, and the cranial contents are broken up and removed.

After perforation and excerebration some operators allow labor to terminate by the natural efforts, while others deliver by means of forceps, cranioclast, cephalotribe, or version. In most cases there is nothing to be gained by waiting, and it is generally safer and better to deliver without any unnecessary delay.

With the strong French forceps, which is a powerful compressor, it is sometimes possible to deliver the perforated head; but the ordinary forceps is too feeble an instrument, and is apt to slip unless the disproportion is very slight. When no other extractor is available, forceps delivery can be made less difficult by washing away the brain-substance completely and removing portions of the cranial bones with short craniotomy forceps. Care should always be taken to protect the passages from injury by sharp spicules of bone during extraction. The forceps proves more useful in the delivery of the perforated after-coming head; there is then far less risk of slipping or of wounding the soft parts.

Notwithstanding the warm commendations of Tarnier, Taylor, and others, version after craniotomy must be regarded as a dangerous operation in most cases. When labor is protracted the uterus tends to retract about the body of the child and the lower uterine segment becomes distended. Attempts to turn under such circumstances, especially if any spicules of bone protrude from the opening in the skull, must expose the mother to serious risks.

Cranioclastis.—The cranioclast is a tractor, not a comminutor, and the operation of cranioclastis consists in getting a firm hold of the mutilated head with the cranioclast and delivering it through the narrowed passages, not in crushing or breaking up the cranial bones. The solid blade, held in the right hand, is guided through the opening made by the perforator and is pushed well down to the base of the skull. The fenestrated blade is then applied to the outside of the skull, directly opposite the blade which is inside; the blades are locked, and the compression-screw is tightened until the head is firmly grasped between them. The blades will be less liable to slip if the outer one is applied to the face rather than to the occiput. Before locking, the handles should not be held horizontally, but should be depressed, so as to make sure of including the chin in the bite. Before beginning to extract, the cranioclast should be so turned as to bring the longest diameter of the head into the transverse diameter of the pelvis. During extraction the left hand should be kept in the vagina to guard the perforation and to protect the maternal soft parts from being injured by projecting edges of bone. The line of traction should be in the axis of the pelvis, the same as in the forceps operation. If any pieces of bone protrude, they should carefully be removed before traction is continued. In difficult cases it may be necessary to strip back the scalp and remove the parietal bones by means of small craniotomy forceps; the blades of the cranioclast can then be so adjusted as to get a good grasp of the frontal bones and the face, and extraction will be easy. Occasionally it will be found easier to introduce the fenestrated blade first and to adjust it carefully before passing the solid blade

into the cranial cavity. In most cases the body comes through easily after the head has been extracted. If the body is so large that it cannot be delivered with a moderate amount of traction, it should be perforated between the clavicle and the scapula, and the cranioclast so adjusted that the fenestrated blade is applied over the back. The cases are extremely rare in which delivery cannot be accomplished by perforation and cranioclast.

Cephalotripsy.—Occasionally the fetal head is too large or too much ossified to be delivered safely with the cranioclast, and it becomes necessary to crush it in order to reduce its bulk. *Cephalotripsy* is the name given to this crushing and extraction of the fetal head. When the operation was first proposed, it was hoped that it would supersede perforation; but this hope has not been realized, and at the present day, when the head is presenting, it is almost invariably perforated before being crushed. The cephalotribe in general use is a powerful forceps with slight cephalic curve, fitted with a strong compression-screw at the end of the handles. The blades are introduced like those of the forceps, and when the head has fairly been grasped the compression-screw is slowly tightened. The opening made by the perforator should carefully be watched for pieces of extruding bone while compression is being made, and the maternal passages should be protected during extraction. When the cephalotribe gets a good grasp of the head, it crushes satisfactorily; but the difficulty is to get and keep a good hold, for the head is apt to slip away when the compression-screw is tightened. As Pinard remarks, it is one thing to seize the head with the blades of the cephalotribe, but quite another to hold it while being crushed. Cephalotripsy is indicated when the pelvic contraction is only moderate or slight; but when the contraction is extreme the instrument takes up too much room and the tractile force required to effect delivery is dangerous for the mother. When the conjugate of the brim measures less than 7 centimeters ($2\frac{3}{4}$ inches), the operation becomes difficult; when less than 6.3 centimeters ($2\frac{1}{2}$ inches), it is highly dangerous.

In difficult breech cases, when the after-coming head cannot be delivered by manipulation or by forceps on account of slight pelvic contraction, its bulk may be reduced sufficiently by cephalotripsy even without perforation. Or if perforation has been done and the forceps does not hold, or if it is found necessary to reduce the bulk by crushing the base of the skull, the cephalotribe will be useful. Or if the body has been delivered and the head, which is free in the uterine cavity, cannot be seized and delivered with forceps, it is sometimes necessary to steady the head in the pelvis, fix it by means of a crotchet passed into the cranial cavity, and then apply the cephalotribe to crush the skull before it can be extracted. In all such cases the maternal tissues should be carefully guarded against injury.

At the present day cephalotripsy is seldom done; when craniotomy is indicated and the pelvic contraction is only moderate or slight, perforation and cranioclast usually suffice; when the pelvic contraction is extreme, basiotripsy or Cesarean section is preferable.

Basiotripsy.—Basiotripsy is an improved cephalotripsy that in France has

completely taken the place of the latter operation whenever pelvic contraction is moderate or extreme. The steps of the operation are perforation, the small crushing, the great crushing, and, finally, extraction. The perforator, held in the right hand, is guided along the fingers of the left hand to the point selected for perforation; kept at right angles to the skull, it is then thrust through the cranial bone and pushed along until its point is imbedded in the base. The short blade, which corresponds with the left or lower blade of the forceps, is introduced like the forceps-blade, and is articulated with the tenon on the handle of the perforator. The compression-screw is then adjusted and tightened until the short blade is forced close to the perforator; the hook is closed down, which securely fastens the short blade to the perforator. This procedure is the small crushing. The compression-screw is removed, and the long blade is applied like the right or upper blade of the forceps and articulated with the tenon on the handle of the short blade. The compression-screw is again applied, and slowly tightened until the long blade is brought close to the perforator. This operation is the great crushing. If the instrument has been properly applied, the vault and base of the skull will have been crushed and flattened by the operation to a little less than 2 inches, and extraction is comparatively easy. Tarnier and his followers set 4 centimeters ($1\frac{1}{2}$ inches) of the conjugate as the lowest limit for basiotripsy. Below this limit the mother is exposed to risks as great as from Cesarean section, but above 6 centimeters ($2\frac{3}{8}$ inches) the maternal mortality is practically *nil*. Pinard operated fifteen times consecutively without a death, the conjugate in one case measuring only 6 centimeters ($2\frac{3}{8}$ inches). This operation was done forty-nine times without a death in the practice of Pinard and his colleagues, and in all the cases the puerperium was normal.

Decapitation and Evisceration.—These operations are indicated (1) in neglected transverse presentations with impaction, where version is dangerous or impossible and the head cannot be brought down far enough for craniotomy; (2) when a monster or some pathological enlargement of the fetal structures renders delivery otherwise impossible. Decapitation is indicated when the neck of the fetus is within reach and a hook can be passed over it; evisceration is indicated in all other cases. These operations are always difficult and dangerous. The impaction of the fetus interferes with manipulation, while the uterine tissues are thinned and liable to be injured or be ruptured by the hands or instruments.

For *decapitation* Braun's hook (Fig. 531) is the simplest and most efficient instrument; it is less liable to injure the mother than the more complicated contrivances. Before operating the bladder should be emptied and the parts thoroughly disinfected. An arm is then brought down and a tape is attached to it, so that an assistant may make traction when required. The whole hand is then passed into the vagina, palm upward, with the thumb close to the symphysis and four fingers in the hollow of the sacrum, until the neck is clasped between the thumb and the middle finger. If the head is lying toward the mother's left side, the left hand is introduced into the vagina; if the head points to the mother's right

side, the right hand is introduced. The hook, with its concavity pointing away from the head toward the body, is grasped in the other hand, palm downward, is passed along the thumb of the inside hand, and is guided over the child's neck until the tip touches the operator's middle finger. During the passage of the hook it should lie all the time beneath the thumb and the fingers, which should not be separated. The neck is put on the stretch by pulling the handle of the hook firmly downward (Fig. 535) while an assistant draws down the arm by means of the tape. While strong traction is being made the handle is quickly raised as far as possible, and twisted forcibly *from head toward breech*, turning the palm of the hand upward. Three or four twists (Figs. 536, 537) are generally sufficient to sever the head from the body. Throughout the operation the inside hand must protect the maternal tissues from injury. Twisting should never be done unless the hook is clasped between the thumb and the finger of the guiding hand. As soon

as the neck is divided the head recedes, and the body is easily delivered by pulling upon the prolapsed arm; the head is subsequently extracted with for-

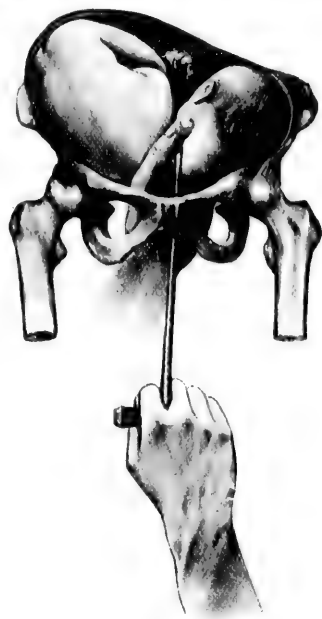


FIG. 535.—Decapitation with Braun's hook.



FIG. 536.—Braun's hook seizing the cervical vertebra and rotated.

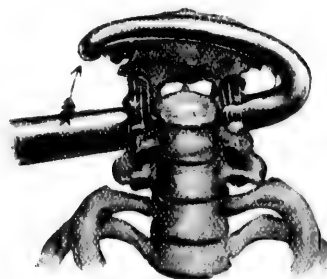


FIG. 537.—Braun's hook rotated in the opposite direction; the spinal column giving way.

ceps or the cephalotribe. During the extraction of trunk and head the maternal passages should be guarded against injury from the ragged ends of the

severed vertebræ. If Braun's hook is not available, a strong cord may be carried around the neck by means of a gum-elastic catheter, and the soft parts be sawn through by pulling upon the ends of the cord; or a long, blunt-pointed scissors may be used to snip through the tissues, always taking care to guard the points.

Evisceration may be accomplished by opening either the thorax or the abdomen with blunt-pointed scissors, and breaking up the internal organs and removing them by means of a volsella; or the scissors-perforator may be carried up to the most accessible portion of the trunk, and an opening be made through which a crotchet or a metal nozzle can be introduced to break up the internal organs. The operation is very tedious, and great care must be taken not to injure the uterus or the passages. After any pieces of loose bone have been removed the blunt hook may be introduced, and an attempt may be made to extract the trunk by pulling it down and bending it upon itself. If this manœuvre fails, nothing remains but to dismember the fetus and deliver it piece by piece. Chain-saws and embryotomes of more or less complicated pattern have been devised for use in difficult cases; but they are seldom available when wanted, are difficult to apply, and are apt seriously to injure the maternal passages. Symphysiotomy has been advised in these difficult cases, to give more room for manipulation and extraction. Pinard, however, protests strongly against the use of symphysiotomy for the delivery of a dead or mutilated fetus, maintaining that the mother's chances of recovery are thereby much impaired. Cases are occasionally met with where the ordinary methods of decapitation and evisceration are not feasible. Spencer¹ of University College, London, has recently drawn attention to two such classes of cases: (1) When it is impossible to deliver the body after the head has been extracted, on account of unusual size of the body or of pathological conditions in the serous cavities or the viscera; (2) when the back of the fetus presents, rendering decapitation impossible. In the first class, when traction fails to deliver, he suggests snipping through the clavicles (cleidotomy) and introducing a blunt hook into the axilla to bring down the arms, or decapitating and then passing the hand over the thorax and opening the abdomen. Care must be taken to seize the neck with a volsella before decapitating, to prevent the trunk from receding out of reach after the head is removed. In the second class he suggests snipping through the spinal column with a pair of scissors, seizing the trunk with a cranioclast, and so drawing it down that it can be snipped through. The two halves of the body can then readily be delivered.

After-treatment.—After the mutilated fetus has been delivered and the placenta has come away, a hot antiseptic uterine douche should be given, and the parturient canal examined for traumatism, which should be repaired immediately. During the puerperium the chief danger is sepsis, and the treatment should be regulated accordingly.

Prognosis.—The prognosis of embryotomy depends in great measure upon the degree of disproportion present, the condition of the patient, the stage of

¹ *British Medical Journal*, April 13, 1895, p. 808.

labor, the nature of previous attempts to deliver, the amount of injury done to the maternal tissues, and, above all, upon the presence or absence of sepsis. When the disproportion is not extreme, and the operation is done early, before the patient has become exhausted by a protracted labor or by futile attempts to deliver, when the maternal soft parts have not been bruised and lacerated, and when all the manipulations have been done with strict antiseptic precautions, the mortality should be very low. Craniotomy may be a very easy or a very difficult operation, according to the degree of disproportion and the stage of labor at which it is done. Other things being equal, embryotomy is more dangerous than craniotomy. In private practice there are many difficulties and disadvantages to overcome, which are not encountered in well-arranged maternities; consequently the mortality may reasonably be expected to be higher; but, unfortunately, it is far higher than it ought to be, owing in great measure to the want of early and exact diagnosis, and to the prevailing tendency on the part of the general practitioner to postpone operation until forceps and version have repeatedly been tried and have failed. The brilliant results in Paris of basiotripsy show the possibilities of the operation when done early in suitable cases. There can be very little doubt that early operation and strict antisepsis would minimize the chief immediate dangers, rupture and sepsis, as well as the risks of subsequent pressure-complications, such as fistulæ. But we can scarcely look for much improvement in our results until the profession as a whole comes to have clearer ideas respecting the limitations as well as the indications of the destructive operations, and is more generally possessed of a sensitive "antiseptic conscience."

II. MANUAL OPERATIONS.

VARIETIES AND METHODS OF VERSION.

Version is a manual operation, designed to bring about a partial or a complete change in the relation of the long axis of the child to the long axis of the mother, whereby a longitudinal is substituted for a transverse presentation, or one end of the child is substituted for the other. The *object* attained is the exchange of a less favorable presentation which nature cannot deliver, such as a shoulder, for a presentation that is favorable for expulsion, such as a head, a breech, or a footling; or, in such an emergency as placenta prævia or a contracted pelvis, a change of the presenting part from head to foot in order to secure speed or ease in delivery.

Omitting the study of the infrequent cases in which nature can compass version, and which have been considered under the head of *Mechanism of Labor* (p. 489), we find three *varieties* of version: (A) cephalic, (B) pelvic, and (C) podalic, and three *methods* of version: (1) external, (2) bipolar, and (3) internal.

Varieties.—Cephalic version causes the head to present; pelvic version, the breech; and podalic version, one or both feet.

Choice of Variety.—For cephalic version an easy case, an ample pelvis, and

labor not under way are the ordinary conditions; pelvic version is an occasional early preparation for labor with placenta prævia; while podalic version is our chief reliance in urgent or difficult cases.

Methods.—External version is accomplished by manipulation through the abdominal wall. Bipolar version is effected by passing two fingers through the cervix and tossing along the successively presenting parts of the child until the leg can be seized, while the external hand does its part through the abdominal wall. For internal version one hand is pushed freely into the uterine cavity to grasp the foot or the knee, on which traction is made while the other hand assists from without.

Choice of Method.—In a typical case we should attempt the correction of the presentation by the three methods in the order named. The indications for each method will be given in its proper section, but they may be summarized here:

1. *The external method* is not often employed, because its success depends on a combination of conditions that is seldom found. It is the simplest and safest procedure, and will be more often required as early recognition of the position of the child by abdominal palpation becomes more common. It demands the presence of the liquor amnii, or at least a relaxed uterus and abdominal wall, with free mobility of the child, and is usually available only before labor or early in its course.

2. *The bipolar method* has the advantage over the internal method in that "it can be performed at the commencement of labor, long before the os is completely dilated, and that it obviates the necessity of introducing the whole hand into the uterus, which is not without danger to the parturient and the child." But it is not always easy or feasible.

3. *The internal method* is the obstetrician's chief reliance, especially in urgent or difficult cases, but it is many times an operation of no little moment.

Indications for the Operation: A. *Indications for Cephalic Version.*—Breech presentation calls for cephalic version when all conditions are favorable—such as a sufficiently roomy pelvis—and when it can readily be accomplished by the external method before labor by a practised hand. Under such circumstances shoulder cases will also be amenable to this variety of turning.

B. *Indications for Pelvic Version.*—As this manœuvre is rarely employed, its consideration may be brief. It is only undertaken by the method of external version, as by other methods we bring down one or both feet. It is indicated for placenta prævia and for a slightly-contracted pelvis before labor or early in labor.

C. *Indications for Podalic Version.*—Stated in the order of their importance, the conditions under which version should be chosen are:

1. In transverse presentations, which are chiefly shoulder cases. This indication is the most frequent, and includes all except small or macerated fetuses, and the few instances in which cephalic version is preferred.

2. In normal pelvis and head presentations, when the life of the child or

that of the mother is threatened, if the head cannot be induced to engage and the cervix is not dilated so that forceps can be applied. This indication includes placenta prævia, except in the simpler marginal variety with the head low in the pelvis, and scant bleeding. It also covers cases of prolapse of the cord not otherwise manageable. In certain instances with prolapse of one or more extremities, and chiefly when the foot presents, podalic version is our resource, as also in the most troublesome face or brow presentations with the head at the inlet, when the posture of the head cannot be rectified manually, and particularly in posterior positions. Lastly, in certain other emergencies, should the case call for rapid extraction, we employ version, as in eclampsia and in accidental hemorrhage.

3. In contracted pelvis. Version is called for in flat pelvis where the true conjugate is not below 8 centimeters ($3\frac{1}{2}$ inches), where there is a relative disproportion between passage and passenger equivalent to the above-named contraction, where the head does not engage and changes its position frequently above the brim, or where previous breech deliveries have been more favorable than vertex presentations, and also "in obliquely-contracted pelvis and unsuccessful or unfavorable engagement of the head with the occiput over the contracted side."

Contra-indications to Version.—Rigid and permanent contraction of the wall of the uterus, especially in dry labors; high position of the retraction-ring (5 to 7.5 centimeters—2 to 3 inches—above the symphysis—Winckel); engagement of the head; impaction of the presenting part which would require dangerous pressure to dislodge,—all contra-indicate version.

Dangers of Version.—Rupture of the uterus, shock, increased risk of sepsis, hemorrhage, and laceration are the hazards for the mother. In external and bipolar version these dangers are usually insignificant, because we rarely use much force in these procedures, but in internal version there is risk of uterine rupture. It is for this class of cases that we urge the necessity of firm gentleness and the avoidance of operation in the presence of pronounced tension or thinning of the uterine wall. There is, of course, no obstetric operation more likely than version to infect the mother if the operator does not carry out aseptic measures, except, perhaps, that of Cesarean section. The danger of laceration and of shock is proportionate to the rapidity with which the child is turned and extracted, and to the lack of skill of the operator. To the child the dangers are fracture of the femur or the humerus, together with the usual risks of breech labors.

CEPHALIC VERSION.—"As head presentation is the type of natural labor, it follows," says Barnes, "that to obtain a head presentation is the great end to be contemplated by art, but practically head-turning is little known. Delivery by the feet is almost universally practised when the substitution of a favorable for an unfavorable presentation has to be accomplished. Why is this? The answer rests chiefly upon the undoubted fact that in the great majority of instances, at the time when the mal-presentation comes before us, turning by the feet is the only mode of turning which is practicable." It may

also be noted that lack of certainty concerning presentation and position, due to defective training in abdominal palpation, leaves the patient without help until the time has passed for the milder manipulation.

Conditions for Cephalic Version.—For a favorable outcome by this method, labor should not yet be under way, or should not be so far advanced that there is any marked tension of the uterine walls. The liquor amnii should be present, and the abdominal walls neither tense, tender, nor thickly padded with fat. Among transverse conditions we prefer an obliquity that is moderate, with the shoulder not yet driven down into the pelvis. To convert a breech into a vertex presentation, not only must these favoring circumstances be present, but the operator should also be endowed with skill in version and experience in abdominal palpation, so that his manœuvre shall not be arrested halfway and a breech case be converted into a transverse presentation.

The *advantages* of cephalic version are evident, and in the presence of a sufficiently capacious pelvis should induce skilled operators to undertake this measure. The *disadvantages* consist in the limited scope of the procedure and the experience required.

Steps of the Operation.—Cephalic version is practically confined to the external and bipolar methods, and the steps are the same as in these methods, which are described on another page, except that the fetus is to be moved in the opposite direction from that described under podalic version. If the operator prefers to do version with the woman lying on her side, she should be on the same side as that on which the head is found. Supposing the case to be one in which the head is in the left iliac fossa, and the fundus, with the breech, is to the right of the mother's spinal column, the woman is to be placed on her left side. In this posture the fundus of the uterus, loaded with the breech and being movable, will tend to fall toward the dependent side.

1. **External Version.**—This method, the simplest and safest of the three methods of turning, will become more commonly employed as the general practitioner adopts the habit of a thorough examination by abdominal palpation a month before labor for each pregnant woman under his care. Whenever possible, it should be attempted before the other methods are begun. As Fritsch well says: "Even to-day, when the danger from sepsis is small, a successful external version means the achievement of large results through little means."

Indications for External Version.—The indications, in general, are the same as those that apply to all versions, the special *conditions* required being the presence of the liquor amnii or its recent loss, leaving a relaxed and insensitive uterus with free mobility of the child. External version should be undertaken only when it can be performed without violence; this period, as a rule, is before labor is actually established, or at any rate before rupture of the membranes. It may be performed with advantage for a high transverse position of the second child in twin labors.

Contra-indications.—External version cannot be effected when there is a macerated fetus, or in case of twins, or where the presenting part has sunk

deep in the pelvis, or where the amniotic fluid is small in quantity; neither is it practicable, as a rule, where an excess of fluid causes marked tension of the uterine wall, as in such cases the fetus cannot be retained in its new position. It is seldom adapted to cases where a rapid termination of the delivery is indispensable. Malformations of the uterus and tumors are rare contraindications.

There is no *danger* connected with this operation. Its manifest advantages are that neither sepsis nor shock can result from its use.

The best *time for operation* is at the end of pregnancy, just before the onset of labor, because, later, uterine contractions impede the manœuvre. Earlier, as at the seventh month, one sees transverse presentations in the multipara that rectify themselves, but version may be undertaken early, or, indeed, at any time during the first stage when the conditions above mentioned exist. If begun during labor, the manipulations should not be persisted in so long that the uterine wall takes on firm and persistent contraction—a condition which renders the other methods very difficult.

Preparation for External Version.—The bladder and the rectum should be emptied, and the woman placed in the horizontal dorsal decubitus, the head and shoulders moderately elevated, and the lower limbs slightly flexed with the knees apart. Anesthesia is not required unless the patient is extremely sensitive.

Steps of the Operation.—The hands are applied to the bare abdomen and the diagnosis is carefully confirmed. A hand is then placed on each end of the fetal ovoid. In transverse cases the head is lifted toward the fundus and the breech is driven down toward the inlet by a succession of moderate impulses which are checked as soon as a uterine contraction is produced, while whatever gain has been made is carefully held until the uterine wall again relaxes. A method that has merit is the following: The operator seizes the opposite ends of the fetus with the palms of his hands facing each other, the fingers of one hand opposite the wrist of the other, the hands lying parallel. The power is exerted by simple flexion of the fingers moving in unison, and although the position of the hands may seem forced, they will be found to work easily (Fig. 538). Alternating pushes, first on the head and then on the breech, most readily dislodge and turn the child. These strokes are made in rapid succession upon the two extremities, one hand giving a movement of ascent and the other a movement



FIG. 538.—External version: arrows show the direction in which the ends of the fetus should move.

of descent. Cephalic version should first be tried in transverse presentations wherever the pelvis is sufficiently large and it is not likely that hasty extraction will be required, or the tampon action of the leg will become necessary as in placenta prævia.

If it is attempted to replace a breech by a vertex presentation, the first step of the operation consists in lifting the breech into one iliac fossa while at the same time the head is driven to one side. As in all other methods, the end of the child to be brought down is made to follow the shortest possible arc that will bring about the desired result. This will be accomplished by pushing the head in the direction of the occiput and the breech in the direction of the feet. Patient and repeated attempts should be made, but the woman should not suffer pain, though she may be subjected to some discomfort. When the turning is effected, a vaginal examination is to be made to make sure that the desired fetal pole has been brought to the inlet.

Retention after Version.—Having succeeded in altering the presentation, it will be found that the causes which produced the former presentation will tend to reproduce it; therefore we either bandage the abdomen to retain what we have gained, or, if labor is under way, we make sure that the presenting part becomes well engaged. The bandage may be one of two kinds—either an impromptu affair of flannel or of unbleached muslin, like the ordinary binder, to which a longitudinal pad on each side is carefully fitted and fastened, or one of the abdominal bandages to be found in any large instrument-store, reinforced, if necessary, by lateral splints or padding. Pinard's bandage has long inflatable pads on the sides and straps under the thighs. If labor is under way and the new presenting part does not engage well, the patient may remain on her back, watched by the obstetrician or the nurse, or on that side from which the presenting part was dislodged, with a firm pillow under the uterus to prevent undue sinking. In certain cases it is advisable to rupture the membranes to make sure that the child remains in the desired position.

2. Bipolar Version.—*Indications.*—The foregoing general rules apply also to the bipolar method of version. The special conditions necessary are that the liquor amnii be wholly present or so recently present that the child is still movable in a fair degree, and that the cervix admit two fingers, while the vagina must tolerate the presence of the rest of the hand if necessary. "It is one of the natural consequences of a shoulder presentation that the cervix is but rarely found dilated enough for turning and delivery until after, perhaps long after, the indication for turning has clearly been present. The shoulder does not dilate the cervix well."

The *advantages* of the bipolar method over the internal method are that there is less danger of infecting the uterine cavity in its deeper parts, and that it permits the operation to be done when the dilatation of the cervix is but slight. Its *disadvantages* are that the finger-tips have but a limited control over the parts of the child that successively come within reach, and the method is therefore usually restricted by its limitations to those transverse cases in which one has not far to reach or far to turn in order to bring the

child's knee into the cervix; nevertheless this resource should always be kept in mind.

The preferred *time of operation* is early in the dilatation stage when the cervix is passable for two fingers.

Preparation for Bipolar Version.—Anesthesia is not necessary nor usual, but it should be a preliminary procedure with an excessively sensitive or restless patient. The parturient lies on her back across the bed, with her hips near the edge, and her feet on the edge of the bed or supported by assistants or on chairs. Working short-handed, one may pass a rolled sheet under the patient's neck and tie the ends about the knees, to keep them flexed. The forceps is wrapped in a towel and boiled, to be at hand in case arrest of the after-coming head should suddenly demand it for a difficult extraction. With the forceps, scissors, episiotomy knife, needles, needle-holder, catch-forceps for quick seizure of the cord, douche-bag and tube, tape, and silk or silkworm gut are sterilized by heat. The douche-bag is filled. Towels, steamed, fresh-laundered, or wrung out of solution, gauze, iodoform or zinc-oxide gauze for tampon, basins, and solutions are ready for use. The diagnosis is confirmed; the hands of the operator are rendered sterile, the vulvar hair is clipped close, and the vulva and its vicinity, the lower abdomen, the inner sides of the thighs, and the vagina and cervix are lathered and douché.

Steps of the Operation.—The fingers of the hand that correspond in name with the side of the mother to which the presenting part is to be pushed—the left hand if the shoulder is to be pushed to the left—are slipped through the cervix into the uterus, the remainder of the hand being inserted into the vagina only when the presenting part is at such distance as not otherwise to be reached. The outer hand grasps that end of the child which is to be brought into the cervix. A simple and efficient way to keep this hand from contamination is to wrap it in a sterile towel or to lay-across the abdomen of the mother a towel wrung out of a warm disinfectant solution.

Let us suppose that we have a vertex presentation, the occiput to the left and front, to be changed to a breech presentation. The head must be sent in the direction in which the occiput points—in this case to the left. We now begin “the simultaneous action on the two ends of the fetal ovoid, the fingers of the internal hand pressing the head-globe across the pelvic brim and lifting it upward toward the left iliac fossa; the hand outside pressing the breech across to the right and downward toward the right ilium (Figs. 539, 540). The movements by which this is effected are a combination of continuous pressure and gentle taps with the finger-tips on the head, and a series of half-sliding, half-pushing impulses with the curved hand on the breech” (Barnes). As the head is lifted out of the brim on to the shelf of the iliac fossa and is passed on, the shoulder moves along into its place. Then the chest, elbow, or knee comes within reach, but further away and at times almost too high for touching. When the arms and legs are completely flexed the knees of the child are found about the height of its navel or against its chest. Meanwhile the outer hand crowds the breech well downward to bring the

knee within the grasp of the fingers passed into the uterus, and the nurse or assistant is requested to lift the head upward. As soon as a knee comes within reach it should be seized. When a choice can be made, the lower or near knee should be chosen in a dorso-anterior position of the child (Fig. 543), and the remote knee in a dorso-posterior position; that is to say, the lower of the two in the case we are considering. Often one cannot choose, but breaks through the membranes (if they are intact) and gets down either leg or both legs without ado, as the finger-touches cannot determine the matter so readily as does the full hand-grasp of internal version. [A full consideration as to the choice of foot is found on page 950.] Still applying power to the ends of the fetal ovoid, the version is completed by drawing the leg down into the vagina to secure the engagement of the breech. If the arm is prolapsed, Braxton Hicks advises that it be flexed and pushed up over the anterior surface of the thorax, first noosing a fillet about the wrist. In applying the above method to a transverse presentation (Figs. 540, 541) the steps we have described are undertaken so far as they apply—that is, one begins by tossing along whichever part first comes within reach of the inner fingers. Moreover, while we have described podalic version because it is the more common, cephalic version can be accomplished by the same procedure.

3. Internal Version.—By this method, which is the most effective and the most commonly employed, as well as the most dangerous, the hand is passed into the uterus deeply enough to seize one or both feet and to bring them through the cervix. The *indications* are those already described on page 942, and the same may be said of the *contra-indications*, with emphasis on the fact that the reasons there given apply with their fullest vigor to this method, which in neglected cases may constitute a difficult and hazardous operation.

The *conditions* necessary for the performance of internal podalic version—and podalic version is practically the only variety undertaken by this method—are rather numerous:

1. The mother must not be in gravest danger, for in such case version cannot save her. The child is likely to be so weak as certainly to die during the process of turning and extraction; and the fetal life could only be saved by Cesarean section immediately following the mother's death.

2. The pelvis must be sufficiently ample to allow free passage of the hand,



FIG. 539.—The first step of bipolar podalic version: two fingers within the cervix lift the head toward the iliac fossa, while the breech is crowded over toward the other ilium.

so that the fetal part can be grasped securely and the living fetus extracted. For the live child a true conjugate of not less than 8 centimeters ($3\frac{1}{2}$ inches) will be desirable with a fetus of ordinary dimensions.

3. The cervix should be completely dilated, or in a multipara almost completely dilated, and at the least be freely dilatable and easily passable for the hand without injury; for if rapid extraction is necessary the cervix must permit ready passage of the head, and to secure this it should be large enough to allow the closed fist to pass. A note must always be made in passing of the size and dilatability of the orifice, for there is no more annoying obstruction than to find the after-coming head firmly retained by a powerful india-rubber-like band applied about the neck.* Where the dilation is not complete version is not forbidden, for we resort to it in cases of placenta prævia in



FIG. 540.—Bipolar version: the shoulder and arm are pushed along; the breech is pushed downward.



FIG. 541.—Bipolar version: the knee is almost within reach, the head is pressed upward.

order to plug the bleeding canal by the thigh or the breech and wait for dilatation, and we are not deterred by the case wherein the elastic tube fits the head snugly, because incisions will permit us to extract rapidly if this become imperative.

4. The uterus must not be tetanically contracted about the child, for under such conditions there is imminent danger of rupture; therefore the obstetrician tries to ascertain whether there is a transverse ridge, the retraction-ring, between the symphysis and navel, and how high up it has been drawn.

5. The child should not be crowded too deeply into the pelvis, but should

*The circumference of the cone-shaped hand is from 20 to 24 centimeters (8 to $9\frac{1}{2}$ inches), that of the closed fist from 25 to 28 centimeters (10 to 11 inches), while that of the flexed head is from 30 to 33 centimeters (12 to $13\frac{1}{2}$ inches), so that the closed fist should pass loosely to ensure rapid extraction of the after-coming head.

be sufficiently movable to allow the presenting part to be pushed back. Neither must the fetus be too large. If premature (before twenty-eight weeks) and dead, and macerated, no operation is likely to be needed. Most favorable will be the case wherein the child is relatively small, the uterus lax, the cervix open, the membranes intact, and the mother insensitive.



FIG. 542.—Dorso-anterior position: the hand is passed directly across the child to seize the near foot.

Dangers of Internal Version.—The dangers, as has been said, are rupture of the uterus from the employment of undue force, and sepsis caused by uncleanness, together with laceration, hemorrhage, and shock.

The *advantages* of this method are the complete control of the fetus and its evolutions which it affords.

Choice of Foot.—Before proceeding to operate, we must have a clear idea of



FIG. 543.—Traction on the near leg is made diagonally across the mother's pelvis to pull the child's breech into the inlet.

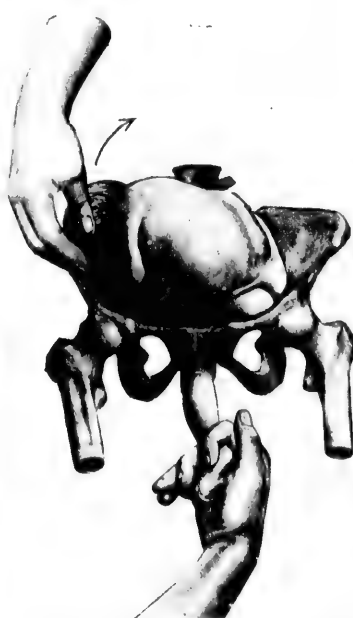


FIG. 544.—Traction made directly downward leaves the breech seated on the iliac fossa and requires useless force.

the mechanism we desire to institute, and we shall diverge from our practical study to consider conflicting theories and teachings, since there is much differ-

ence of opinion as to the most advisable, expeditious, and successful method. The question at issue is whether to seize one or both feet, the near or the remote foot, or the remote foot in certain cases and the near foot in certain other cases. We state, theoretically, the most advisable method, but we do not pretend to make hard-and-fast rules. In practice we often do—not what we would, but what we may. We may summarize the discussion by saying that traction on either foot will rightly effect the version, but that it is preferable to bring down the remote foot in dorso-posterior positions of the child, and the near foot in dorso-anterior positions.

The simplest method is to seize *either* foot indifferently. Some operators (Nagel, Grandin, Fritsch) endorse this practice. In the most difficult cases where the pressure of quick-recurring uterine contractions or the emergency during a hemorrhage is such that one is happy to be able to reach either lower extremity; or in case only one can be found; or with an operator who has not been thoroughly trained by manikin teaching or who is without sufficient experience and possesses cloudy ideas of position and mechanism,—this course is a sensible one to advise. Traction on either leg will bring about version. It is merely a question which leg will most efficiently produce the desired



FIG. 545.—The breech enters the pelvis with traction in the right direction.

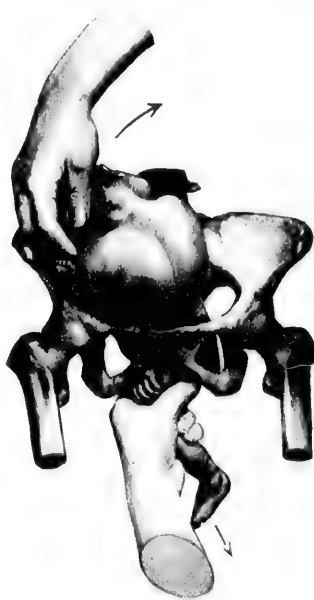


FIG. 546.—New seizure on the thigh: the leg on which traction is made being the anterior leg in the pelvis.

result; therefore, for the novice let us say that either foot should be seized if he is unable to get both.

The *near foot always* is chosen by certain operators (Winckel, Lusk,



FIG. 547.—Dorso-anterior position; seizure of the remote foot.

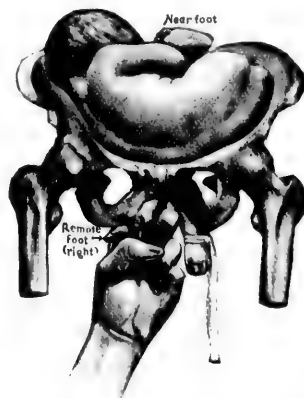


FIG. 548.—The remote foot drawn in a diagonal direction through the mother's pelvis.

Schroeder, Galabin), except with a freely movable child, because it is simpler



FIG. 549.—The upper buttock is moving down, and the lower shoulder rising.

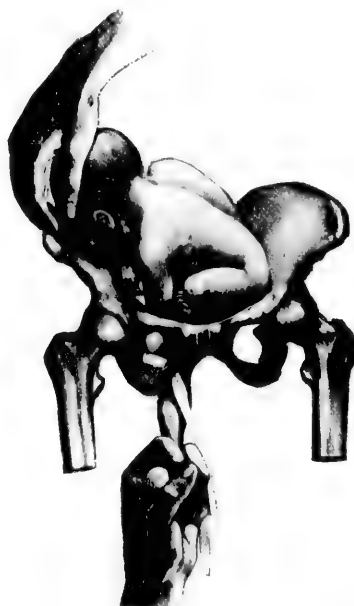


FIG. 550.—The breech enters the pelvis, the leg on which traction is made being the posterior leg in the pelvis.

and less difficult, and because "only a revolution (Figs. 542-546) about the

child's sagittal axis occurs, to which is added later one about its long axis, when the hip which has been brought down engages under the symphysis." In pulling on the upper foot "a revolution (Figs. 547-552) about the long axis, and then one about the sagittal axis, and finally a short revolution about the long axis of the child occur, and a disastrous lifting of the arms is produced." This objection to traction on the remote leg has force in dorso-anterior cases only.

The *remote foot always* is sought by certain teachers (Simpson, Kristellar, Earnes). "The proper knee to seize is that which is farthest. We have, for example, a right dorso-anterior position (Fig. 547); the right arm and shoulder are downmost, and these parts have to be lifted out of the brim. How can this be done? Clearly, by pulling down the opposite knee, which, representing the opposite pole, must cause the shoulder to rise, the movements running parallel in opposite directions like the two ends of a rope around a pulley" (Fig. 549). "If only the foot of the same side as the presenting arm is seized, the effect is to increase the wedge and the impaction." In Figure 543 it will be seen that traction on the leg is like pulling on the stalk of a T, of which the horizontal bar is represented by the body. Moreover, in transverse cases the breech is usually further from the median line than the head, and the near leg may pull in the long axis of the child at a disadvantage.

The inadvisability and the bad mechanics of traction on the posterior leg, as compared with traction on the anterior leg, are well shown in Figure 560, (A-C). It needs but a glance to see that the pull in the direction of the



FIG. 551.—The leg on which traction is made has passed over from the left to the right side of the mother's pelvis.



FIG. 552.—The leg which was posterior in Figure 550 is now anterior.

arrow of Figure 560, A is at an angle which in no way coincides with the

axis of the inlet of the pelvis, whereas the pull indicated by the arrow in Figure 560, c, is at a much more favorable angle. Figure 560, b, shows rotation under way. Nagel demonstrated clinically that the leg swings the long way round the mother's pelvis.

The Near Foot in Dorso-anterior Positions—The Remote Foot in Dorso-posterior Positions.—In dorso-anterior positions the near leg should generally be brought down. A strong argument in favor of this method may be drawn



FIG. 553.—Dorso-posterior position: the hand is passed in directly to seize the remote foot, the mother in the dorsal posture (see Fig. 562).



FIG. 554.—The foot is drawn down; assistance by means of the hands without is shown.

from these two facts—first, that in pulling the breech through the brim after turning, it is of great advantage to make traction on the leg which will come at once to the front behind the symphysis, and secondly, by this means the fetus never loses its dorso-anterior position. But in bringing down the upper foot the child's face is turned to the front, requiring a subsequent rotation of the trunk to bring about a dorso-anterior condition, which is required at a further stage of the extraction in order readily to deliver the shoulders and head. This will best be demonstrated by consulting the two series of figures (Figs. 547–551) illustrating the stages of the procedures here set in order. It will be seen that one evolution is simple and that the other is complicated; that in one case the rotation of the body on its long axis is entirely avoided; and that a very important consideration argues for the simpler procedure—namely, that the chances of throwing the arms above the head are materially lessened by the method of traction on the near foot. When there is firm contraction of the uterus it is rightly objected that pulling on the near foot will more tightly wedge the parts, and that it will be necessary to push the head higher up in the iliac fossa in order to loosen the obstruction. But

in the presence of such relaxation as would justify version the simpler method is advisable.

In dorso-posterior transverse positions the remote leg should be brought down. Here the back of the child is at the rear, and traction on the upper leg after the change in the long axis has been effected will bring about an anterior position of the dorsum of the child. To secure this condition promptly, the upper leg is the one to seize, as shown by our graphic argu-



FIG. 555.—Traction is made diagonally across the mother's pelvis to dislodge the breech; the leg brought down is now the anterior leg.



FIG. 556.—The child slips farther down.

ments (Figs. 553-556). As one pulls on the remote foot the body rolls over, the upper buttock follows over a course toward the front and becomes lower than its fellow, while the spine is strongly curved. Imagining the fetal trunk to be a flat block of wood, the traction on the upper or sacral corner of the block forces the diagonal, or opposite, corner—the impacted shoulder—to rise.

A Single Foot.—The advantage of bringing down one foot instead of both feet is that the second leg applied along the fetal trunk ensures a larger mass (made up of the breech and the flexed thigh) by which the cervix will be wedged more fully open for the benefit of the larger after-coming shoulders and head, than will be the case where this wedge is decomposed and both legs are brought down, leaving a dilating mass of the calibre only of the child's hips. The circumference of the hips, with both legs down, is somewhat over 25 centimeters (10 inches), while that of the breech, with one leg up, is 28 to 30 centimeters (11 to 12 inches).

Both Feet.—When the cervix is widely dilated, when the most rapid extraction is called for, or when the uterus is not well relaxed, both feet may be brought down. The middle finger is passed between the child's ankles when seizing both feet, and the other fingers surround the ankles. If seizure of the foot is difficult or if straightening of the leg is impeded, the leg may be brought down by making pressure in the popliteal space, thus flexing the thigh alongside the trunk toward the back and side of the child and giving more space in which to pull down the foot (Fig. 561). In some cases the finger may be hooked over the knee, and the knee drawn downward in a



FIG. 557.—Dorso-posterior position: the rear leg has been brought down.



FIG. 558.—The child's breech enters the pelvic cavity.

flexed condition, extension of the foot being effected farther down in the birth-canal, but usually this method is troublesome.

In all the above difficulties the outer hand supplements the work of the inner hand, pushing or feeding the desired part within reach of the fingers working in the uterus.

Choice of Hand.—No stress is laid on the choice of hand, because the feet of the child usually lie within equally easy reach of either hand, near the center of the uterus. The hand that is most readily used depends somewhat on the position in which the patient is to be delivered. In general one chooses that hand which, in a given case, will most conveniently pass in to the leg to be brought down, in such a way that the sensitive surface of the fingers will be turned toward the part to be examined and grasped—the palm toward the child's abdomen. Thus in the case shown in Figure 542, the patient

in the dorsal posture with the fetal abdomen to the rear and the feet to the mother's left, the left hand works more easily into the deep hollow behind the child. In dorso-posterior positions, or in cases of pendulous abdomen, there is often difficulty in passing the hand into the cavern above the symphysis because of the troublesome backward bend at the wrist-joint (Fig. 553). In such conditions the latero-prone posture is of value, in combination with the expedient of passing the hand along the lower lateral wall of the uterus, the patient lying on that side on which the child's feet are situated (Fig. 562).

Preparations for the Operation.—Internal version may be undertaken in an emergency with no assistant except a nurse, but one works at a great disadvantage, and would prefer to have one medical man as anesthetizer, and a

second to assist, besides the nurse, who will have enough to do in carrying out directions that may be given her. Whenever possible the operation should be performed on a table. A large enema should always be given. The catheter should be used if sitting on the chamber and the application of hot cloths to the vulva fail to induce an evacuation of the bladder.

To prevent undue soiling of the bed, the floor, or the operator's person—for this is one of the bloody operations—some ample receptacle, such as a pail, dish-pan, or child's bath-tub, should be placed on the floor, and to guide the fluids into the vessel a Kelly pad, or a waterproof, or table cover, or some newspapers under sheets should be spread beneath the hips. Over these and next to the patient a sterile towel

FIG. 550.—The child's trunk is fully within the pelvis, but further rotation is necessary to bring the leg to the front.*

or one wrung out of an antiseptic solution should be laid. The operator protects his clothing with a rubber apron or by a sheet tied under the arms.

A well-equipped instrument-table will contain a large basin of hot water for the scrubbing or to resuscitate the child, a basin of antiseptic solution in which the uterine douche-tube, connected with a filled douche-bag, may conveniently lie; green soap and brushes; gauze or towels to be used as sponges and in seizing the child; a bandage or strip of gauze; a fillet; scissors; silk or silkworm gut for tying the cord; an episiotomy knife for the cervix or vulva, and forceps for the after-coming head. The assistant who administers the ether is at hand with restoratives, a hypodermic syringe, and ergot.

* I am indebted to the beautiful work of Farabeuf and Varnier for the suggestions from which many of the illustrations to this article were made. For all of my cuts photographs of the pelvis and fetus were taken and painted over (Robert L. Dickinson).

Anesthesia is required for all sensitive patients in most of the difficult operations and whenever complete relaxation of the abdominal and uterine walls is essential, because the walls of the cavity become tense as the hand pushes in, and may take on a more or less continuous form of contraction. Narcosis is usually desirable to relieve the pain of the operation and to prevent struggling on the part of the patient. It is to be omitted where such favorable conditions as the open vulva of the multipara, a fully dilated cervix, and flabby and insen-

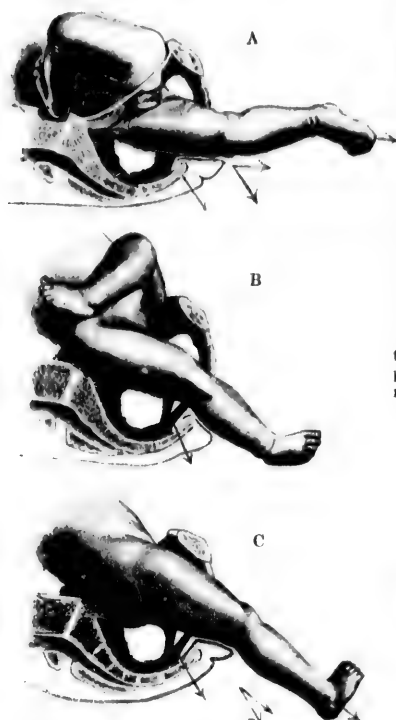


FIG. 560.—A, traction on the posterior leg: the lower arrow shows the axis of the inlet, the arrows to the right, the axis of traction; the buttock is caught on the brim. B, continued traction is rotating the leg to the position of C. C, traction on anterior leg: the arrows show that the pull is nearly in the axis of the brim (modified from Farabeuf and Varnier).

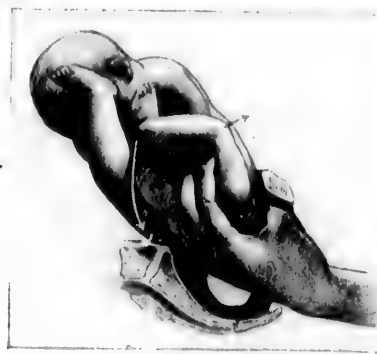


FIG. 561.—To bring down a foot when it is against the face the knee may be bent by pressure in the popliteal space (modified from Farabeuf and Varnier).



FIG. 562.—Dorso-posterior position: the hand passes easily along the side wall of the uterus to seize the feet.

sitive uterine and abdominal walls are present, or when serious heart disease forbids its use. It may be discontinued as soon as turning is accomplished. Ether produces less complete relaxation than chloroform.

In no obstetric operation is thorough *antisepsis* more urgently demanded. The operator's sleeves are rolled up nearly to the shoulder and pinned, a rubber apron or a sheet is fastened about him, and his hands and forearms are thor-

oroughly scrubbed. Then the hair is clipped, and the vulva, the inside of the thighs, and the abdominal wall are lathered with gauze, soap, and hot water. Scrubbing should be done with a brush after anesthesia is under way. This cleansing is eminently desirable, because occasional contact with the skin-surface is hardly avoidable. In cases of haste or in an emergency there may only be time enough to scrub off the vulva and to wrap the outer manipulating hand in a clean towel. The desirability of keeping that hand aseptic is evident from the frequent necessity for a change of hands by which the outer becomes the inner hand at a time when valuable minutes would be lost in cleaning a contaminated outer hand.

Next, the vagina is well lathered with a wad of gauze and green soap, every fold being stretched and scrubbed. The douche is then given. If time and material serve, each leg should be rolled in a separate sheet and the covering secured with safety-pins. In our hospital work the patient wears a pair of combination stocking-drawers tied about the waist. The sheet-sling (Fig. 563) is employed when working short-handed. A clean towel, or one wrung out of an antiseptic, on a chair or table, holds the instruments, which have been wrapped in another towel, and which have been boiling ten minutes while the patient was being shaved and anesthetized.

Posture of the Patient: Dorsal Posture.—Usually the patient is laid with buttocks close to the lower end of the table or across the bed, her thighs flexed and supported by assistants or, in cases in which the operator works very short-handed, by the sheet-sling (Fig. 563). The shoulders may be low; a



FIG. 563.—The sheet-sling: a sheet caught by diagonally opposite corners and rolled is passed under the neck and flexed knees. To keep the legs well apart the knees should be widely separated before the feet are allowed to drop into this position.

pillow under the hips covered with water-shedding material will lift the pelvis advantageously, and a light blanket protects the body from chilling. This posture is most commonly employed, because it is the only one that allows free play to the outer hand; the chances of infecting the outer hand are lessened; if working alone, one can better direct the anesthetic and watch the breathing;

and extraction can be completed in the position in which version has been accomplished. The accompanying illustrations (Figs. 564-566) show that with

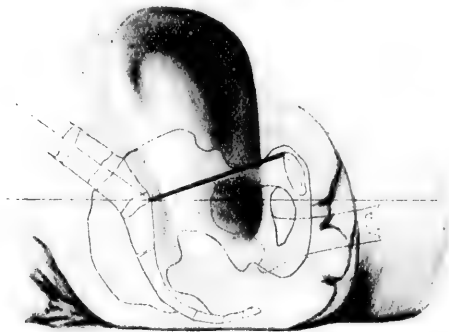


FIG. 564.—Dorsal posture with thighs flat on the bed: the heavy black line indicates the conjugate of the brim and its relation to the horizon.

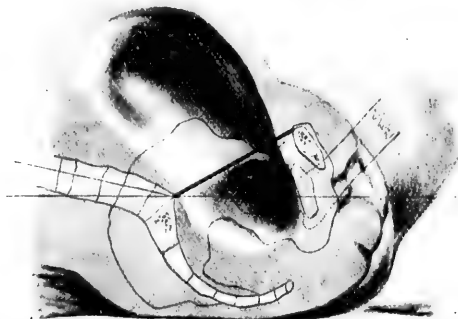


FIG. 565.—Dorsal posture with moderate flexion of the thighs when the feet rest on the edge of the table.



FIG. 566.—Dorsal posture with strong flexion of the thighs against the abdomen; most ready access to the fundus.

well-flexed thighs the operation will be easiest. When extracting the after-coming head, or whenever additional space in the conjugate diameter of the

brim is demanded—6 to 9 millimeters ($\frac{1}{4}$ to $\frac{3}{8}$ inch)—the thighs may be extended to their utmost over the edge of the table or bed. This is the *Walcher* posture (Fig. 567). It will be seen that the axis of traction at the inlet in this posture must be almost directly downward.

Latero-prone Posture.—If the patient is placed on her side, as is advisable

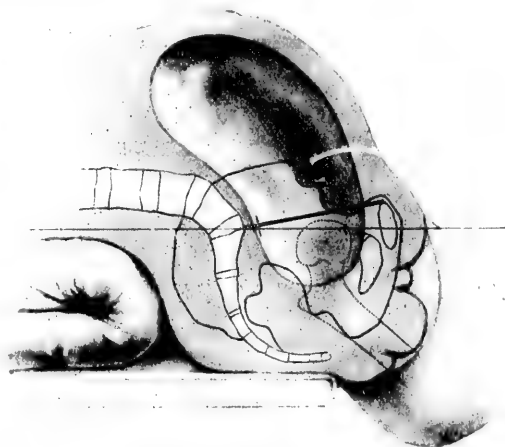


FIG. 567.—Walcher posture: the conjugate of the brim is a black line, and the amount of space gained is a dotted continuation of this line.

in dorso-posterior positions, it should be on the side on which lies that end of the fetus which it is desired to bring down; that is, when the breech is to the right the mother should be placed on the right side. By this method the operator stands behind or in front of the patient in such a way that he faces in the same direction as the child. The necessity for the operator to assume these positions is somewhat less imperative if he proceeds by slipping his hand beneath the child along the lateral aspect of the uterus, since he can then easily pass his hand in either direction (Fig. 568). This method is particularly available in dorso-posterior positions and in cases of pendulous abdomen, because in these one can reach into the bay-window-like uterine cavity above the pubes to seize the feet without that distressing backward bend caused by the over-extension of the wrist-joint about the symphysis that is required in operating in the dorsal position (Fig. 553). The right hand would naturally



FIG. 568.—Lateral posture for version: the hand is passed along the side wall of the uterus to the feet. Better adapted to dorso-posterior positions.

be employed with the patient on her right side, and *vice versa*. Later, when the feet have been drawn well down into the vagina, the patient may be turned over on the back to facilitate the external manipulations necessary to complete the turning.

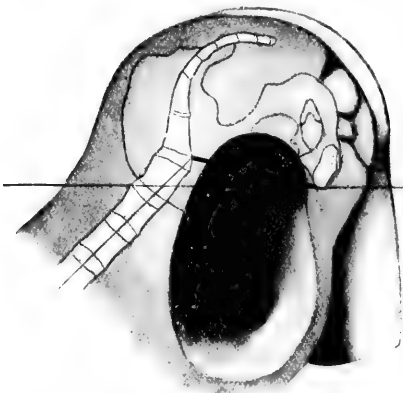


FIG. 569.—Diagram of knee-elbow posture for internal version. The lower part of the hollow of the uterus is lifted out of the pelvis.

bed, directing the patient to bend herself double over this hammock, and operating over the foot of the bed near which she knelt.

Trendelenburg Posture.—This posture is available for anesthesia, for which



FIG. 570.—Improvised Trendelenburg apparatus for external version by means of a chair laid on its face on the bed. For internal version a chair without rungs is used, the legs of the patient being tied to the hind legs of the chair. This is available in Cesarean section.

the knee-chest attitude is almost out of the question. The necessary inclined plane is easily improvised by turning a chair on its face, as shown in Figure 570. If internal version is to be done in this attitude, a chair without rungs

must be used, the buttocks must lie against the back edge of the chair-seat, and the thighs be tied to the back legs to allow working space between the thighs.

As a general rule, it is wise for the operator to use that position with which he is most familiar.

The squatting position in its most extreme form, when the thighs are strongly applied to the sides of the abdomen, is said to have some effect in diminishing the transverse diameter and increasing the longitudinal diameter of the uterus, and might be tried before other measures.

Examination.—Whenever external examination has left any doubt as to the exact position of the child, the fingers, or even the whole hand, passed into the uterus will yield the desired information. During this search the rate of pulsation of the cord may cautiously be determined and a low implantation of the placenta be recognized.

Steps of the Operation.—The steps of the operation are four in number: (1) The introduction of the hand; (2) recognition and seizure of one or both feet; (3) turning of the child; (4) extraction of the child.

After completing the preparations just described and having confirmed the diagnosis of position, the obstetrician determines which hand to use and which foot to seize, and whether to pass the hand along the back or front or alongside of the fetus. He nooses a fillet on the child's wrist if the arm is in the cervix, and he proceeds with the first step of the operation, which is the—

Introduction of the Hand.—The sterile hand is anointed on its external surface with vaselin, unless a lubricating antiseptic solution is used, such as 1 per cent. creolin or lysol; the tips of the fingers and thumb of one hand are so placed together as to form a cone; the vulva is drawn wide open with the fingers of the other hand, the operating hand being slowly pressed through the vulva by a rotary motion. To pass the hand in front of the fetus the elbow should be brought down low, even if it is necessary to kneel to do so. To pass the hand in behind the child, the fingers should be slipped up to one side of the promontory, which may seem to jut further forward than normal because it can be so plainly felt. The operator should push steadily but gently through the cervix, and having passed that opening should flatten out the hand and "slowly slip it along without violence, without hesitation, steadily upward to the fundus, interrupting its progress only if a contraction commences, and quietly awaiting its passing away before further advance."

If the membranes are unruptured, it is advisable to break through them a short distance within the cervix, unless pulsating loops of cord are detected. In the latter case a new and more circuitous path toward the foot may be chosen before rupture. One is loath to let part of the waters drain away, with the possibility of bringing the cord down, but when the hand is passed deep between the membrane and the uterine wall, it is difficult or impossible to determine quickly what part one seizes through distended membranes. Working within the amniotic sac leaves an important natural covering on the uterine wall and protects the uterus against contact and infection.

The operator's fingers are held together to prevent the cord from slipping in between them. The hand may keep to the side of the child's body (Fig. 562), particularly in oblique cases, to avoid the cord, as the latter is easily compressed if the hand is passed roughly across the child's belly. Compression of the cord is avoided whenever possible; if unavoidable, the remainder of the operation is hastened. "From the time one commences to penetrate into the uterus, happy to be able to push aside the engaging part, always watching to employ a force that is moderate, but continued and real—the other hand, free to act without, is applied over the fundus to slide the breech downward and to bring it to meet the hand within. Without this support the upward pressure of the inner hand might rupture the uterus or tear it from the vagina" (Farabeuf and Varnier.) When the hand has been introduced along the child as far as the navel the knees will be encountered. The feet are usually found near the fundus, applied to the child's breech. In a few instances the feet of the child are against its face, or its knees are within easy reach of the entering hand; under such conditions the fingers need make but a short excursion into the uterine cavity. In most cases, however, one must push on frankly and fearlessly to the fundus, and need not hesitate to slip the arm into the vulva up to the elbow, in order that the finger-tips may reach well beyond the fetus (Fig. 542), and readily curved backward to secure a firm hold on the feet; "lacking this there is no easy going. One wanders vaguely below the level of the feet, hesitating. Deep in the uterus, on the contrary, one readily seizes the feet, and from that moment is master of the situation" (Dubois; see Figs. 547, 562). The early mistake of students and practitioners on the manikin, and of internes in the wards, according to the writer's experience, is to waste time in half-hearted and fruitless attempts to seize parts of the infant out of reach.

Seizure of the Foot.—At this stage the operator should pause to examine the large number of limbs that seem to be crossed in front of the child, in order to distinguish the hand from the foot, and, if desired, between the near and the remote foot. The foot is readily recognized by the large knob of the heel. The flexed knee points toward the head, the flexed elbow toward the breech. Nothing need hurry one except the numbing of the operator's hand under pressure. It is embarrassing to pull down an arm. If but one foot is found, it should be seized; if both feet can be had and the cervix is wide, both may be brought down. The foot is to be seized between the bent index and the middle finger, one over the projecting heel, the other over the arch (Fig. 549), or, indeed, in any possible manner (Fig. 554).

Turning.—The operator now draws the leg downward to the sacral hollow and across the patient's body in the direction of the child's head (Fig. 554). If the breech is to enter the pelvis on the mother's left side (Fig. 543), he should pull across to the right, while at the same time the external hand is pushing the head up toward the fundus with considerable vigor (Fig. 545). The assistant's hand may well be employed, meanwhile, in pressing the breech downward. After the foot has been drawn well downward and ver-

sion cannot yet be effected, before attempting to grasp the other foot one should secure the first foot with a fillet passed by means of a catch-forceps (Fig. 571) up over the wrist of that hand of the operator which holds the foot, and fastened about the ankle. Failing still, the inner hand lets go the foot; the outer hand, steadying the breech and pushing downward, slips along to the shoulder and head and pushes up between the pains, returning to pull upon the leg. Or, better, a fillet made fast to the foot is seized by the outer



FIG. 571.—A catch-forceps seizes the loop of bandage to slip it up over the ankle.

hand, which draws the foot down through the vulva, while the inner hand is pushed deep in to lift up the shoulder and head, the assistant meanwhile helping as he may externally; but all the precautions we have mentioned should carefully be observed to avoid injury to the uterine wall.

If, in any of these procedures, an arm slips down or a hand is brought down by mistake, a noose is made fast to the wrist in order to prevent the extension of this arm and its elevation above the head during extraction. In some cases when the child is in the transverse position the humerus may be used as a lever to shove the shoulder up and along. The hand invariably becomes numb in a short time, and must be changed for the other

hand. The operation is complete when the child's breech is engaged in the pelvic inlet. To bring the feet through the vagina and out of the vulva, one will have to resort to seizure with a towel, or to the noose about the ankle, the slippery skin of which not affording a good hold to the tired hand.

Immediate Extraction versus Delay.—Having completed the version, one carefully examines the fetal heart and considers the mother's general condition, to decide whether the child shall be delivered at once or whether its expulsion shall be left to nature. In any condition threatening grave danger, such as excessive loss of blood from placenta prævia, threatened rupture of the uterus, slow or very rapid fetal heart (near 100 or close to 200), immediate extraction is advisable. When the cervix is not sufficiently dilated, when mother and child are in good condition, and when there are no indications for immediate extraction, the patient may be allowed to pass out of anesthesia, and the uterus may be expected to expel its contents with its ordinary promptness.

Extraction.—In the section on breech delivery (p. 470) will be found a full description of the different methods of extracting the child when once the child's breech has been brought within the cervix. After a troublesome version, and in any case where much traction on the breech has been required,

the arms are likely to be found in the most difficult position to extract—namely, above the head. The frozen section (Fig. 572) of a patient who died with a ruptured uterus shows the disturbed relations of the arms.

In the ordinary method of extraction the trunk is carried sharply to one side, the posterior shoulder is brought as nearly as possible into the sacral hol-



FIG. 572.—Frozen section of a patient who died of rupture of the uterus (Zweifel): the anterior leg is partly delivered, the trunk fills the pelvic cavity snugly, and the arms and head are located in the elongated uterus high in the mother's abdomen.

low, and the hands are slipped along the back of this posterior shoulder until the operator's finger-tip can reach up near the elbow to swing the arm across the chest of the child. This manipulation, as will be seen in Figure 573, is effective when the elbow can be brought below the inlet, and, as a rule, only then. It is the procedure usually advised in text-books. The writer succeeded in unlocking some very difficult cases by the method advised by Barnes. He swings the rear shoulder well backward, passes that hand whose



FIG. 573.—The usual method of swinging an extended arm across the child's chest to extract it.



FIG. 574.—Rotation of the trunk to bring one shoulder toward the sacrum.

palm most conveniently lies against the child's back, forward under the pubic arch into the vulva, along the child's back and shoulder, following down the humerus as near to the elbow as possible (Fig. 575). Pressure with the finger-tips now swings the elbow across the face in front of the promontory and toward

the upper chest of the child. The writer slips in the other hand along the child's abdomen to extract the arm. The hands are then applied flatly against the sides of the trunk and the body is rotated in order to bring the other

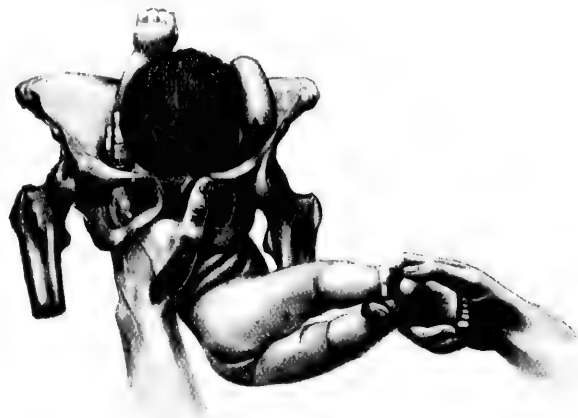


FIG. 575.—The hand passed in under the pubic arch along the arm sweeps the elbow across the child's face (not on the same scale as the preceding).

shoulder toward the promontory (Fig. 574). This manœuvre is repeated on the remaining arm, the operator using the other hand; but usually a deadlock is caused by the jamming of the elbow of the child between its face and the



FIG. 576.—To enable the elbow to pass over the promontory the face must get out of the way. The left hand of the operator therefore rotates the head to free the elbow.

promontory. This difficulty may be overcome by firm pressure with the inner fingers at the same time that the outer hand seizes the occiput (Fig. 576), shoving the latter in the opposite direction from that in which the inner fingers are pushing. This manipulation causes rotation of the head and an ex-

cursion of the forehead in the direction in which the elbow is attempting to move; besides, there is an appreciable diminution of the resistance to the flexing of the arm.

Should this manœuvre fail, the child must be rotated through three-quarters of a circle, so that the arm shall be left behind, as it were, as the body is swept around, thus bringing the arm across the chest. A deep reach will secure the elbow. One must expect, in this procedure, to have the child run considerable risk, on account of the dangerous torsion to which the neck is subjected if the head does not freely follow the body-rotation.

It is claimed that an additional length of true conjugate can be obtained by the Walcher posture, whereby the thighs are drawn as far backward as possible, the patient lying on the edge of the table or the bed (Fig. 567).

Neglected or Impacted Cases.—Considerable judgment will be required in determining how far we dare proceed, and much tact must be exercised in our manipulations, in cases where the uterus has fitted itself firmly about the child. A uterine wall in apparently tonic spasm will sometimes relax. The knee-chest posture or anesthesia to the surgical degree with the patient in the lateral or the Trendelenburg posture is necessary to secure the utmost relaxation. The feet of the child are drawn down while its head is pushed up by one of the methods previously described. In case of failure, or in those cases where impaction of a dead child with permanent contraction of the uterus renders further attempts dangerous to the mother's life, embryotomy is in order. Decapitation is the easiest procedure. Symphysiotomy or Cesarean section may be considered where the pelvis is narrow and the child is living.

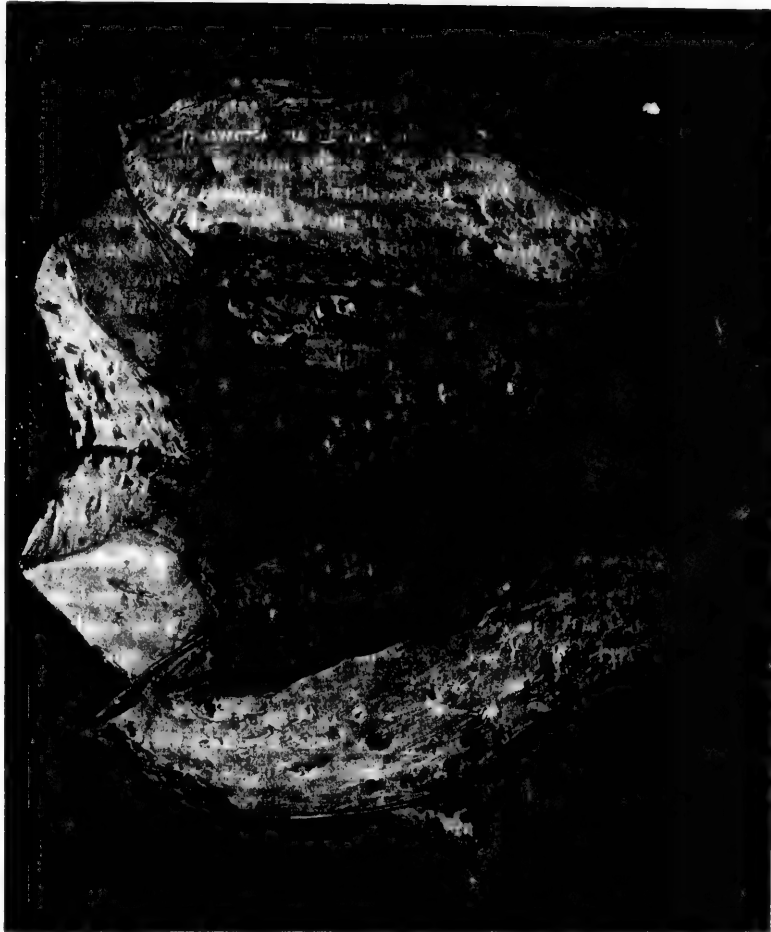
III. CELIOTOMY FOR SEPSIS IN THE CHILD-BEARING PERIOD.

Since the first performance by Tait of abdominal section for purulent peritonitis there has been an extremely important development, especially in the last decade, in the scope of pelvic and abdominal surgery for septic inflammations during the child-bearing period.

Regarded at first as a procedure analogous to opening an abscess anywhere on the body, the whole abdominal cavity being looked upon as an abscess-cavity and the abdominal walls as its capsule, abdominal section for puerperal sepsis has become a generic term of wide significance, including hysterectomy, salpingo-oophorectomy, evacuation of abscesses in the peritoneal cavity and in the pelvic connective tissue, removal of gangrenous or infected neoplasms of or in the neighborhood of the parturient tract, and exploratory incisions.

Indications for Abdominal Section in the Treatment of Puerperal Sepsis.—It is more convenient to deal generically with the indications for abdominal section in the course of puerperal sepsis, for the operation is usually decided upon in practice without reference to what may be required after the abdomen is opened, the prudent and experienced obstetrician holding himself in readiness to perform any of the pelvic or abdominal operations detailed above that may be found necessary when the abdominal cavity is exposed to view and to touch.

In order properly to decide the extremely important and anxious question



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for or against celiotomy in the course of puerperal septic fever, the medical attendant must be familiar with the different forms of sepsis after labor, and should know which of them are most, which are least, amenable to surgical treatment. In a general way it may be stated that the operation is demanded most frequently for localized suppurative peritonitis; it may be indicated, and often is, for diffuse suppurative peritonitis; for suppurative salpingitis and ovaritis; for suppurative metritis, if the inflammation extends outward toward the peritoneal investment of the womb or into the connective tissue of the broad ligament; for abscesses in the pelvic connective tissue; for infected abdominal or pelvic tumors. On the contrary, abdominal section is contra-indicated or is not required in simple sapremia; in septic endometritis of all forms—diphtheritic,* ulcerative, suppurative; in dissecting metritis, sloughing intra-uterine myomata, or in suppurative metritis with the abscess pointing into the uterine cavity; in phlebitis, lymphangitis, and in direct infection of the blood-current. One is most likely to perform an unnecessary operation in diphtheritic endometritis (Pl. 49). The writer has thus erred several times. By the time that symptoms justify surgical intervention in this condition it is always too late.

It is extremely difficult to lay down correct rules for the guidance of a physician in any situation involving so much responsibility, and of necessity so dependent upon many circumstances, as that seeming to require a very serious surgical operation in the midst of an adynamic fever with, very likely, profound depression, rapid pulse, high temperature—in short, with everything a surgeon least desires in the face of a major operation.

First and foremost, then, the attendant should avoid the operative treatment of puerperal sepsis if possible, and should not seek an excuse for surgical intervention merely in the cardinal symptoms of septic infection—high temperature, rapid pulse, and general depression. He should demand some tangible evidence of those forms of sepsis that are amenable to surgical treatment. But the physician of to-day, while reluctant to operate upon a patient under the least favorable circumstances and on his guard against unnecessary or harmful surgery, must be prepared in the event of certain symptoms or complications to operate with the least possible delay.

Thus, on the very first appearance of symptoms that will justify the diagnosis of diffuse suppurative peritonitis, the abdomen must be opened without a moment's more delay than is necessary for an aseptic operation. Even with the utmost promptness the operation will almost always be too late, for the inflammation extends so rapidly and at first insidiously that by the time a diagnosis is possible the progress of the disease cannot be stayed. The writer must admit, however, contrary to his former belief and declaration, that an occasional success is possible by timely surgical interference.†

* By diphtheritic endometritis is meant a dirty, grayish- or greenish-brown exudate on the endometrium, containing mixed micro-organisms, and not necessarily the Klebs-Loeffler bacillus (see Pl. 49).

† Hirst: "A diffuse, unlimited suppurative peritonitis in a child-bearing woman cured by abdominal section," *Medical News*, 1894. A unique case, in the writer's experience.

Again, in the presence of exudate, adhesions, or unnatural enlargement of any pelvic structure, suppuration may be suspected if the physical signs do not improve and if the temperature, pulse, and general condition indicate a continuance of septic inflammation. It is hardly necessary to state that if pus forms it must be reached and evacuated irrespective of its situation. Just how long to wait, however, is a question requiring experience, good judgment, and a special study of each individual case for its correct answer.

Enormous pelvic and abdominal exudates may disappear; adhesions may melt away; enlarged and inflamed tubes, ovaries, and uterus may resume their proper size, functions, and condition on the subsidence of the inflammation; but in these favorable cases distinct signs of improvement manifest themselves in a few days, and the course of the disease is comparatively short. A mere protraction of septic symptoms is in itself suspicious, *along with local signs of inflammation*. Without the latter, the same general symptoms, sometimes lasting for months, mean phlebitis and infection of the blood-current. In this form of sepsis an operation can do no good and may do the greatest harm.

In infected tumors in and near the genital tract the indication for operation should be plain and the decision easy. The presence of the tumor should of course be known. On the first sign of inflammation in it, or in the event of an elevated temperature for which there is no good explanation, the tumor should be removed. Early operations in these cases have furnished the best results, delayed operations the reverse.* In cystic tumors the likelihood of twisted pedicle should be remembered, and in every case of childbirth complicated by a new growth the woman should be watched with extraordinary care to detect the first indication of trouble.

An exploratory abdominal incision should be made, as a rule, only when it is desired to determine if a pelvic mass, presumably containing pus, is situated within or without the peritoneal cavity, and if the abscess had better be evacuated through the abdominal cavity or extra-peritoneally. The writer, in the early period of experimentation with abdominal section for puerperal sepsis, made exploratory incisions in obscure cases without any local symptoms of inflammation in the pelvis or the abdomen, and he has seen a number of such operations in the hands of others. None of these operations yielded information of value, nor did they benefit the patients. Consequently, he adheres to the general rule not to open the abdomen of a puerpera for sepsis unless there are physical signs of inflammation in the abdomen or the pelvis.

Following these general statements in regard to abdominal section for puerperal sepsis, it is now more convenient to describe in detail the different kinds of operations required for the various forms of intra-abdominal septic inflammations.

Abdominal Section for Intraperitoneal Abscesses and Diffuse Suppurative Peritonitis.—The situation and extent of localized suppuration within the

* The most desperate cases, however, need not be despaired of. The writer successfully removed a gangrenous ovarian cyst from a puerpera who was so weak that complete anesthesia was not attempted. The late Dr. Goodell had declined the operation as necessarily fatal.

abdominal cavity vary greatly. The writer has seen a quarter of the abdominal cavity filled with pus, the huge abscess-cavity being thoroughly walled off by dense exudate from the rest of the abdominal cavity. A smaller collection of pus about the orifice of the tube is not uncommon. In one case two or three abscesses the size of an orange were found in coils of intestine quite far removed from one another and without apparent connection with the genital tract. In three cases abscesses were found between the fundus uteri and adjoining structures—the abdominal wall near the umbilicus in one, the caput coli in the second, and the sigmoid flexure in the third. In these cases infection had travelled through a sharply-defined area of uterine wall and had appeared in the same limits on its peritoneal investment. Exudate and adhesions immediately walled off the infected area, with the result of an encapsulated abscess between the uterine wall and the structure nearest to it at the time of inflammation. The treatment of these abscesses consists in their thorough evacuation, the cleansing of the cavity, and drainage. The cleansing may be effected by flushing with hot sterilized water, if the rest of the abdominal cavity can be guarded from contamination. In some cases the writer has avoided irrigation and in its place has thoroughly dried the cavities with gauze with good results. For drainage, as a rule, iodoform gauze will usually be found best. In certain cases of abscesses near the abdominal walls a rubber tube answers better than the gauze, and in deep-seated abscesses on the base and the back of broad ligaments vaginal drainage by means of gauze or rubber tube is much to be preferred. If the work during the operation is well done, there may be little or no subsequent discharge, and douching of the abscess-cavities during convalescence is uncalled for. Occasionally, however, if the abscess-cavity is very large and well isolated, daily douching with sterile hot water is an advantage. In diffuse suppurative peritonitis the remote chance of success depends greatly upon the earliest possible operation, though there are many virulent cases in which nothing could stop the spread of the inflammation and the deadly effect of septic absorption.

This is not the place to discuss the symptoms of diffuse suppurative peritonitis, but one fact should be insisted upon from the operator's point of view. It is usually supposed that true diffuse suppurative peritonitis appears early after delivery; it may, however, develop at any time. The writer has seen it as late as four weeks after confinement. The woman, who had been up and about for some time, lifted an older child down a few steps. The effort squeezed a few drops of pus out of one of the tubes. The abdomen was opened within twenty hours, but to no purpose. The technique of the operation is simple: A small incision is made, and the finger is rapidly swept about the pelvis and abdomen to determine the condition of the organs; then the irrigating tube is passed into the cavity at the lowest angle of the wound and is swept about in all directions, while the return-flow is provided for by two fingers of the left hand distending the sides of the wound, which by the fingers and the irrigating tube is kept gaping as though by a trivalve speculum. Gauze drainage into the pouch of Douglas and the flanks is provided for, and

the wound is left open, or, at most, drawn together by a stitch or two. Rapidity of operation and the smallest possible quantity of anesthetic are essential to success.

Salpingo-oöphorectomy for Puerperal Sepsis.—An acute pyosalpinx in the puerperium is very rare. It is uncommon for acute septic infection after labor to travel by the tubes alone. Infection usually occurs in the uterine muscle, the veins, the lymphatics, or the connective tissue of the pelvis. When the track of the septic inflammation is confined to the mucous membrane of the genital tract, the pelvic peritoneum, in a case serious enough to demand operation during puerperal convalescence, becomes infected, inflamed, and suppuration quickly follows, so that the operation is usually performed for an intra-peritoneal pelvic abscess. The tube may be found somewhat swollen, inflamed, and containing a few drops of pus, and its removal is required; but the pyosalpinx is a subordinate feature in the pelvic inflammation. It is the more subacute case, not usually requiring operation in the conventional period of the puerperium, that results later in a typical uncomplicated pus-tube.

Ovarian abscess is more common than pyosalpinx. The writer has seen the infection travel to the ovary, both by the tube and by the connective tissue or lymphatics of the broad ligament. In the latter case the whole ovary may be infiltrated with a thin sero-pus of a particularly virulent character, and, unfortunately, in excising the ovary the exposure of the infected pelvic connective tissue in the stump almost surely leads to infection of the peritoneal cavity and to a diffuse suppurative peritonitis.

The commonest indication for salpingo-oöphorectomy is furnished by a pus-tube antedating conception. The strain of labor excites a fresh outbreak of inflammation or leads to its spread, and the persistence of septic symptoms with the physical signs of pelvic inflammation justifies operative interference. In one exceedingly instructive case under the writer's charge an operation was performed on a presumptive diagnosis of old pus-tubes, the diagnosis being based mainly upon the patient's history and the existence of serious septic symptoms, with tenderness on abdominal palpation over the region of the tube and ovary. The uterus was much too high in the abdominal cavity to permit of a satisfactory pelvic examination of the uterine appendages. On opening the abdomen a pyosalpinx was found. The patient recovered.

There is nothing peculiar in the technique of these operations. They differ in no respect from similar operations upon non-puerperal patients. The question of removing the uterus along with the tubes will, however, arise rather more frequently than in the non-puerperal woman, on account of the infection of the endometrium or of persistent metrorrhagia.

Hysterectomy for Puerperal Sepsis.—The latest development in celiotomy for puerperal sepsis is the removal of all the pelvic organs and structures that can be removed when the septic inflammation or suppuration involves the uterine muscles and the broad ligaments. Every physician who has seen many cases of puerperal infection during operations or *post-mortem* is aware that there are some in which the mere removal of infected tubes and ovaries or the evac-

uation of pelvic abscesses cannot be expected to save the patient. There would be left behind areas of infected and infiltrated broad ligaments that would surely communicate infection to the peritoneal cavity, or there would remain foci of suppuration or infection in the uterine body that must surely spread to the peritoneum or must result in septic metastases. The only hope for the patient in such cases lies in the entire removal of all infected areas, leaving behind in the pelvis a healthy, non-infected stump. To effect this result the



FIG. 577.—Hysterectomy for purulent salpingitis (Hirst).

excision of the uterus, the broad ligaments, the tubes, and the ovaries is required. In addition to these cases there are others in which, if the tubes and ovaries must be excised, the uterus might be removed with advantage, on account of an infected endometrium or of persistent metrorrhagia. Figure 577 is an example of such a case. The young woman from whom the specimen was removed had a double pyosalpinx following a criminal abortion. For seven weeks she had been bleeding persistently and at intervals had a foul-



FIG. 578.—Suppurative cellulitis of broad ligament; hysterectomy (Hirst).

smelling discharge. Although the body of the woman was healthy and the endometrium was alone inflamed and infected, it was obviously wiser to remove at once all source of the trouble rather than to excise the tubes and ovaries and then to treat separately at some trouble and risk an organ that had become entirely superfluous. The result justified the procedure. There may also be such widespread suppuration and disintegration of the broad ligaments, along with tubal inflammation, that the complete removal of all the infected area is more

easily accomplished, especially as regards the control of hemorrhage, by a hysterectomy. Figure 578 represents such a case. In this woman a pyosalpinx antedated conception. Labor excited fresh inflammation. The infection spread from the tube downward through the connective tissue of the broad ligament, resulting in a partial destruction of it, in a thick infiltration at its base, and in



FIG. 579.—Suppurative and ulcerative metritis, salpingitis; hysterectomy (Hirst).

an abscess between its layers, closely hugging the whole of one side of the uterine body. It was obviously impossible to remove the infected area here without removing the womb as well. The operation, though undertaken under the most discouraging circumstances, was successful.

There can be no doubt as to the necessity of hysterectomy in such a case as that represented in Figure 579. There were abscesses in the uterine wall directly under the peritoneal envelope about to break into the peritoneal cavity; one, indeed, did rupture during the operation. There was a septic ulceration at the



FIG. 580.—Suppurative ovaritis (rear view).

placenta site so nearly perforating the uterine wall that by a light touch during the operation the forefinger passed into the uterine cavity. There was also a pyosalpinx in this case that, judging by the history, antedated or was coincident with impregnation. The operation saved the patient.

Indications for the Operation.—The indications for hysterectomy during puerperal sepsis are furnished by the condition of the pelvic organs when they are exposed to sight and touch after the abdomen is opened. The three cases described above are the types calling for hysterectomy. It is not often possible to determine upon hysterectomy before the abdomen is opened, but it should be remembered that in any abdominal section for puerperal sepsis hysterectomy may be necessary. The careful obstetric surgeon therefore should be provided

with the implements required for amputation of the womb in every abdominal section for puerperal sepsis, and be prepared to remove the womb for any one of the three indications described above, but content with the least radical measure that promises his patient safety. The operation that is quickest done and shocks the patient least is most successful, provided, of course, that it is adequate.

Technique of the Operation.—There are two points in which the technique of hysterectomy for puerperal sepsis may differ from the technique of the operation performed for other conditions. One of these points is the necessity often of doing pan-hysterectomy; the other is the necessity often of tying the ligatures in a broad ligament much thickened by inflammatory exudate.

The writer's preference is strongly for amputation of the womb, leaving as little cervix as possible, and this he always does unless an examination of the cervix by a speculum shows septic ulceration or exudate upon it or in its canal. The reasons for this preference for amputation of the womb over pan-hysterectomy are that the former can be done more quickly, there is not the same anxiety about the cleanliness of the vagina, and the suture material is more certainly guarded from infection afterward.

The thickened broad ligaments are often a source of serious embarrassment in placing and tying the ligatures around the uterine arteries. The writer had this difficulty to contend with in the majority of the operations he has performed. In two instances the inflammatory exudate within and below the ligature broke down into pus, but in both cases an incision in the posterior vaginal vault evacuated the pus and secured an immediate disappearance of somewhat alarming symptoms. In one case it was necessary to do this as late as four weeks after the hysterectomy.

Exploratory Abdominal Section for Puerperal Sepsis.—In the writer's opinion, an exploratory incision should be made only in cases of suspected extra-peritoneal pelvic abscess, to confirm one's suspicion, to be certain that none of the pelvic organs, especially the tubes, are diseased, and to determine the best situation for the incision that shall evacuate the abscess-cavity without contaminating the peritoneal cavity. This rule of practice would exclude exploratory abdominal section in those cases in which there are no physical signs of pelvic inflammation, but in which there is evident septic infection of a nature difficult to determine. As stated previously, the writer resorted to this practice formerly, and has seen others do so, but never with benefit to the patients. There are possible exceptions to the rule, however, as in the case described on page 972, of suspected pyosalpinx without physical signs, owing to the high position of the recently emptied womb and of its appendages.

Figure 581, drawn from life, represents a typical case requiring exploratory abdominal section. The woman had a miscarriage some weeks before the writer's first visit to her. She had lost over thirty pounds in weight, was bedridden, had night-sweats, high fever, profound prostration, and exacerbations of pain in the pelvis. On examination the usual symptoms of extra-peritoneal pelvic exudate and suppuration were found on the right side. When the

abdomen was opened it was found that all the pelvic organs and the pelvic peritoneum were perfectly healthy. There was a large collection of pus between the layers of the right broad ligament, giving to this structure a dome-shape. The tube and ovary running over the top of the distended broad ligament were perfectly healthy and without a trace of adhesion or inflammation of any kind. With the abdomen opened it was easy to locate the level of the anterior duplication of the peritoneum. A mark was made on the skin an inch below this point, the abdominal wound was closed, an incision was made



FIG. 581.—Exploratory abdominal section: incision in groin for extra-peritoneal abscess (Hurst).

in the groin, as shown in the drawing, and the pus washed out by douching. Sinuous tracts of suppuration were found by the finger running up the psoas muscle and down into the floor of the pelvis. Two drainage-tubes were inserted, one upward into the psoas muscle, the other downward into the pelvis. In the course of this woman's convalescence it was found advisable to make a counter-opening in the right lateral fornix of the vagina and to pass a drainage-tube through from the opening in the groin to the vagina. This established perfect drainage, and the patient made a good recovery.

Cases like this of true extra-peritoneal pelvic abscess due to puerperal infection and without intra-peritoneal inflammation are rare. There are some gynecologists who deny their existence, but the writer has had two cases under his charge in which the diagnosis was established by abdominal section.

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[The construction of this INDEX is based on the almost exclusive use of the *noun* as the catch-word, with ample cross-references, and with the introduction of the topical form of arrangement of specific subjects; that is, a dash (—) indicates that topics thus marked are all included under the preceding general head. The **black-letter** type is used to denote the section-heads of the work.]

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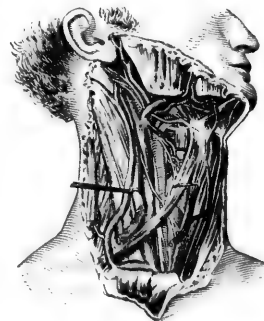


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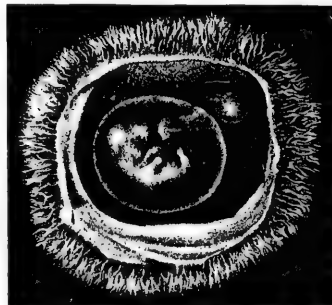
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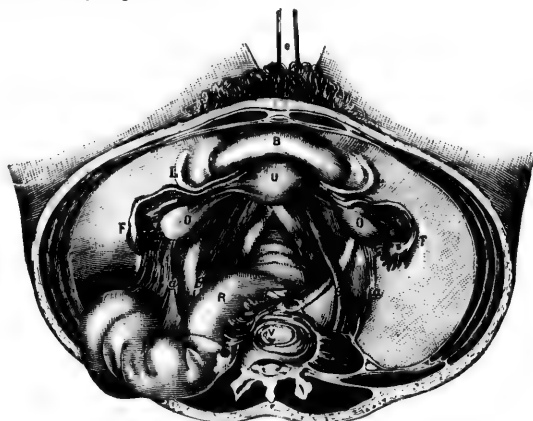
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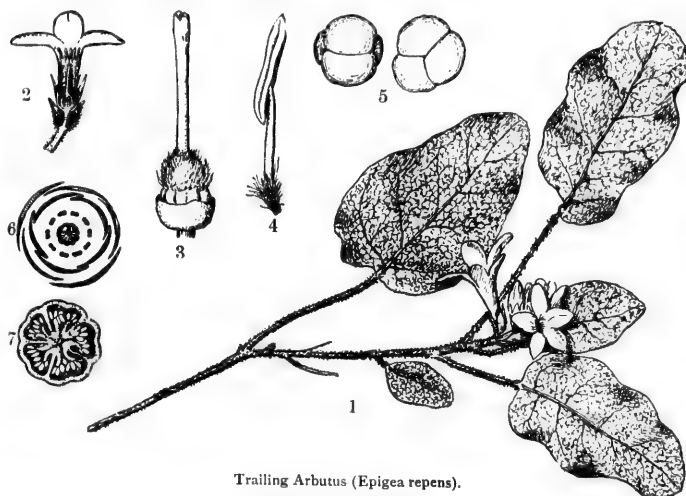
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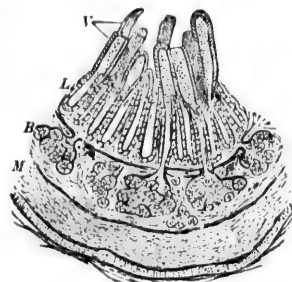
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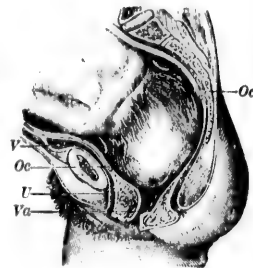
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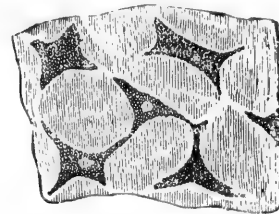
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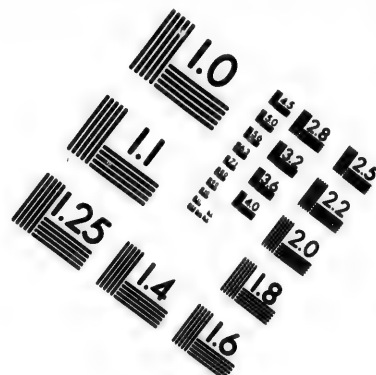
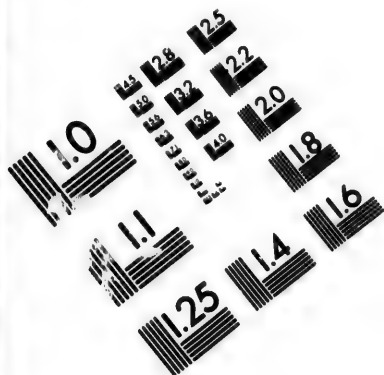
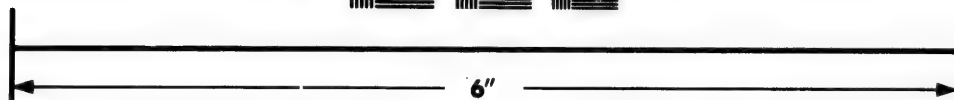
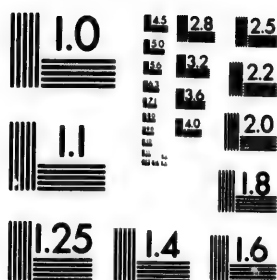


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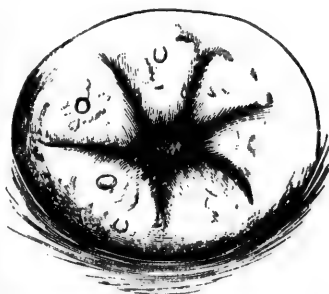
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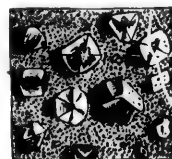
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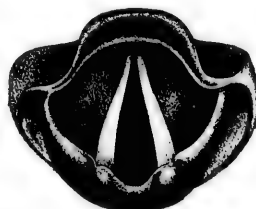
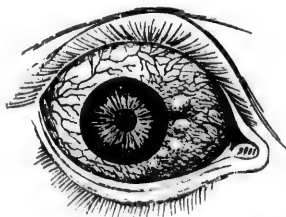
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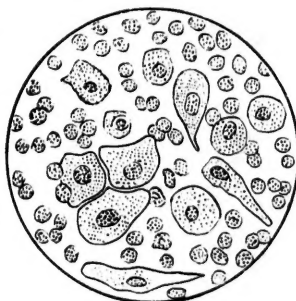
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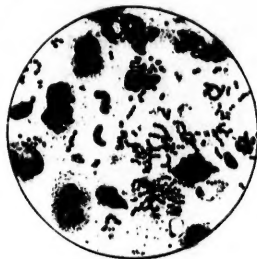
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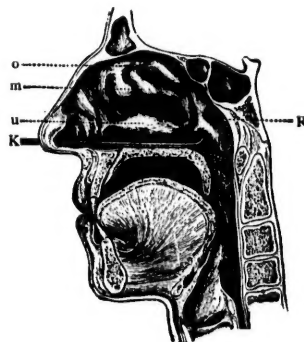
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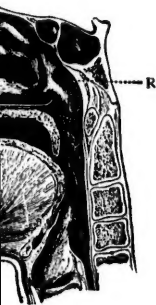


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